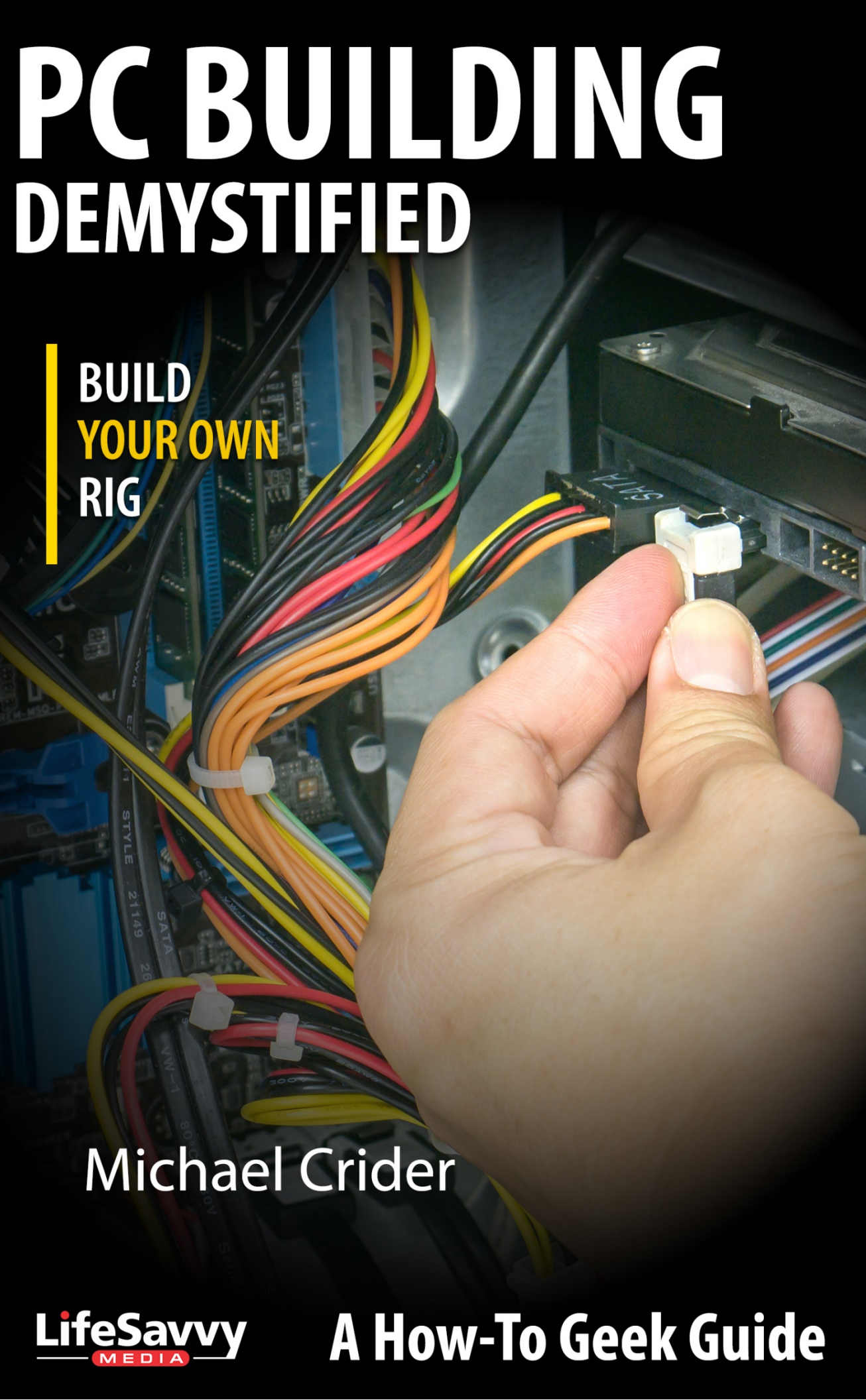
PC BUILDING DEMYSTIFIED

BUILD
YOUR OWN
RIG



Michael Crider

LifeSavvy MEDIA

A How-To Geek Guide

PC Building Demystified

Build Your Own Rig

by Michael Crider

Cover Photo by xfilephotos/Shutterstock.com

LifeSavvy MEDIA

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Introduction

So, you've decided to take the plunge and assemble your own desktop PC. Maybe you're ready to take your PC gaming to the next level, build a tiny entertainment machine, or just save some money by assembling your own budget machine. Whatever your intentions, our five-part guide is here to help you.

Before you can start building, you need a plan. The adage "measure twice, cut once" is in full effect here: you'll want to carefully select your PC components to make sure they're all compatible with each other, and with what you want to achieve. So, this entire article will be about selecting your parts before you ever spend a dollar or touch a screwdriver.

Why Build Your Own PC?

The pros of a home-built PC are many, but it's a good idea to make sure it's right for you. You don't want to get in too deep and regret your decision.

For example, building a PC *can* be cheaper than buying a prebuilt one---but it isn't always! If you're just looking for a general-purpose computer, buying an off-the-shelf Dell is going to be way cheaper than building one yourself. You can't compete with the prices they get on bulk parts. Not to mention they come with warranties---if you're the type of person who needs outside help when something goes wrong, you'll probably be better off with a PC from a store that offers service.

However, if you're a moderately knowledgeable user looking for a more powerful PC (for gaming or video editing) or a more specialized PC (like a compact home theater PC), you are much more likely to save money by building. "Gaming" PCs from companies like Alienware have big markups, and you can save a lot of money by building the machine yourself.

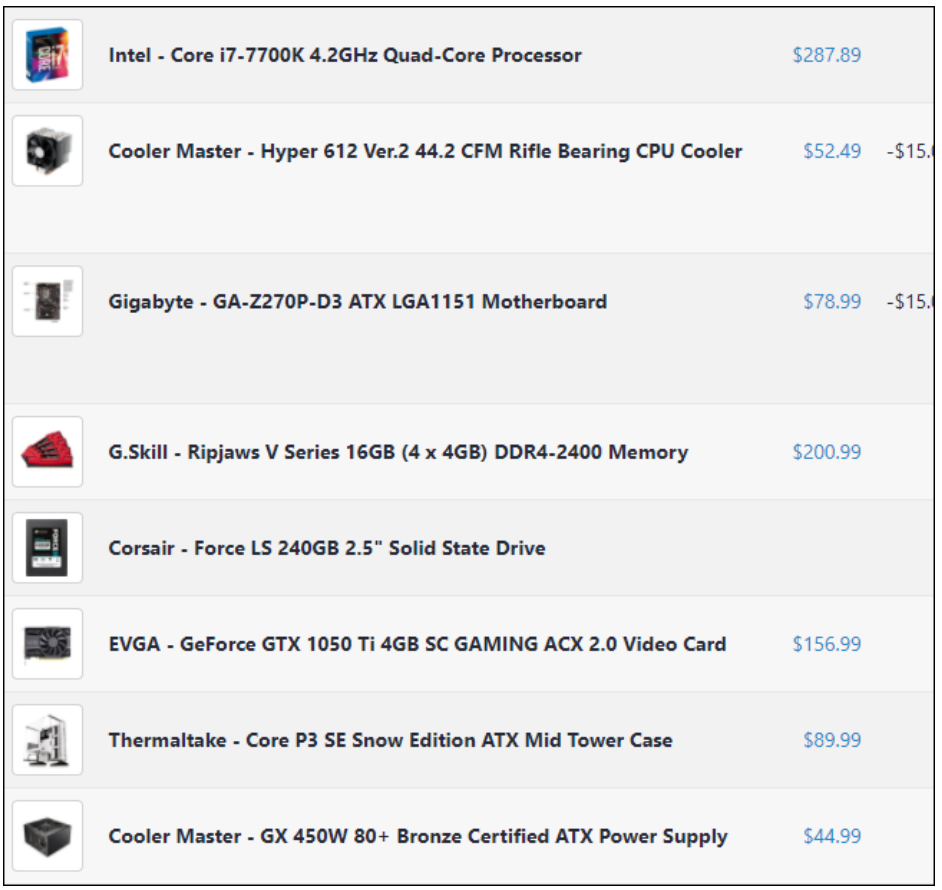
Building your own PC has other advantages, too. You can upgrade it at any time to keep it current without buying a new machine (since there's less likelihood of proprietary or soldered-on parts), or even overclock it to access some extra power.

But the reason I love doing it, and the reason most enthusiasts swear by it, is that there's a satisfaction in personally selecting and handling each part that goes into your computer. It's fun (for people like me, anyway)

in the same way that working on your own car is fun. And, since you don't need years of practice to do it, it's a whole lot easier.

If the length of this guide or the complexity of the components seems intimidating, don't worry. It's kind of like assembling flat-pack furniture or a set of LEGOS with instructions. Everything fits together in a very specific way. If you follow this guide, you'll be just fine.

Part One: Choosing Your Hardware



There are six components that you must use to assemble a working PC. They include:

1. **Case: T**he PC case is what holds all the internal components together in a structure. Also known as an enclosure or chassis.
2. **Motherboard:** The connective tissue of your PC build. Every other component will be attached to or plugged into the motherboard in some fashion.
3. **Processor (or CPU):** The central processing unit, which acts as the "brain" of your PC. This will broadly determine the speed of your computer. You'll have to choose a CPU and a motherboard that are

compatible with each other, both in terms of the manufacturer (Intel or AMD) and the CPU socket itself.

4. **Memory (or RAM):** RAM stands for random access memory. This is a crucial component of your computer's operation. You need to choose RAM that's compatible with your motherboard's RAM slots.
5. **Storage**: Your hard drive (HDD) or solid-state drive (SSD), the part of the computer that holds the operating system and all your digital files. SSDs are much faster than hard drives and are highly recommended these days, though HDDs are generally larger and cheaper.
6. **Power Supply (or PSU)**: A heavy little box that regulates the electricity going into your computer and provides power to the individual components. The power supply will directly connect to the motherboard, CPU (through the motherboard), storage, and other add-on components as necessary.

Those are just the pieces you'll need to get a computer up and running. For more complex builds, you can add any or all of the components:

- **Monitor, mouse, and keyboard**: If you're upgrading from a laptop, you might not have these already. Be sure to buy some or your computer will be an extremely cool-looking brick.
- **Graphics card**: Most CPUs come with onboard graphics that will run daily tasks just fine. But if you plan on playing high-end PC games or running intense media applications, you'll want a separate graphics card that plugs into one of the PCI-Express ports on the motherboard.
- **CPU cooler**: All but the most expensive CPUs come with a heatsink and fan inside the box---this is essential to keeping it from overheating. But if you're planning on using your PC for high-end gaming, or if you want to overclock it at some point, you'll want a bigger, more robust aftermarket cooler. These come in air-cooled and water-cooled varieties. We'll talk about installing both the stock and aftermarket kind in the next article. (Note: You may also need a tube of thermal paste if you buy an aftermarket cooler. Many coolers come with a free tube or with it pre-applied, but check to see if you need to purchase it separately.)
- **Extra storage**: See above. You can add as many hard drives or storage drives as you motherboard can handle, up to its maximum number of SATA ports.
- **DVD or Blu-ray drive**: This used to be more or less required to install an operating system, but these days most users have switched to simply loading up installation files on a USB drive. A separate disc drive is really only useful if you have a lot of media still on discs (like old games, movies, music, or file backups) that you need to access frequently.

- **Case fans**: Most cases will come with one or two fans for basic airflow, but if you're serious about cooling, you'll want to use all the available mounting points. Or, you may want to get aftermarket fans that aren't as loud (or come in cool colors). Whatever you do, be sure to get the correct sized fans for your case! Most fans are 120mm in diameter, but some cases may have 80mm or 140mm fan mounts.
- **Add-on components**: Thanks to PCI-E, SATA, and M2 ports on the motherboard, plus open slots for CD drives, SD card readers, or even older floppy disk drives, you may have room to add more or less anything to your build. Extra USB ports, a sound card, a fan manager—your options are only limited by your build. Just make sure your add-ons can work with your case and your motherboard.

Want to get crazy? There are all sorts of add-ons that you can use, including entirely cosmetic stuff, like lights and cable sleeves. Check out this article if you're looking for a deep dive.

Also, for the assembly of the PC and installing Windows (covered in the following articles in this series), you'll need:

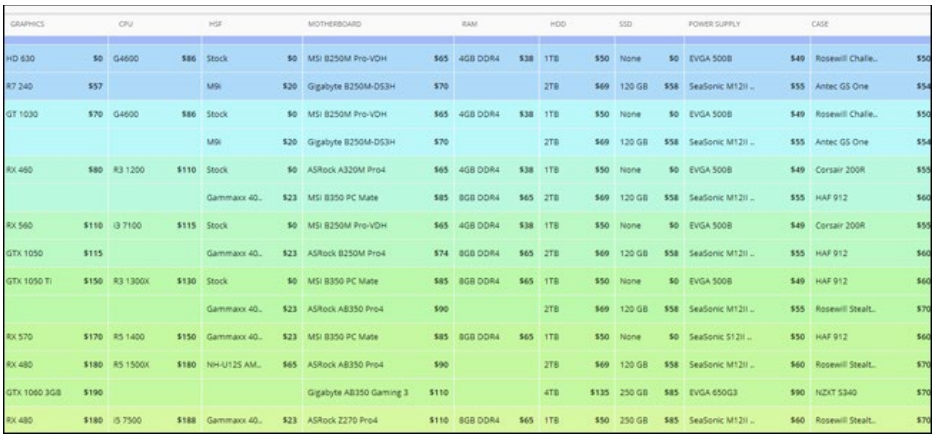
- A screwdriver
- A USB drive with at least 8GB of space
- Access to another working Windows computer (a public library PC should work fine)

With all that in mind, let's talk about where to buy your parts, and how to go about selecting them.

Where Should I Buy My Parts?

If you're looking to secure your parts at retail, it will be tough these days: since computer supply stores like CompUSA went out of business, there aren't many places you can go in the US to find all the parts above in the same store. Best Buy, Fry's Electronics, and Micro Center are more or less the only national chains still going (and they're not even available in all areas). You might be able to find more general parts like graphics cards and storage drives in office supply stores, like Staples and OfficeMax, but you won't be able to buy the whole build there.

If you want computer parts, the best place to look is online. And generally speaking, the best places to look online are Amazon and Newegg (again, in the United States). With millions of parts in stock, they'll generally have the best prices and selection between them. You might be able to find deals on smaller sites, though---it wouldn't hurt to look around a bit.



GRAPHICS		CPU		HSF		MOTHERBOARD		RAM		HDD		SSD		POWER SUPPLY		CASE	
HD 630	$0	G4600	$86	Stock	$0	MSI B250M Pro-VDH	$65	4GB DDR4	$38	1TB	$50	None	$0	EVGA 500B	$49	Rosewill Challe..	$50
R7 240	$57			M9i	$20	Gigabyte B250M-DS3H	$70			2TB	$69	120 GB	$58	SeaSonic M12II ..	$55	Antec GS One	$54
GT 1030	$70	G4600	$86	Stock	$0	MSI B250M Pro-VDH	$65	4GB DDR4	$38	1TB	$50	None	$0	EVGA 500B	$49	Rosewill Challe..	$50
				M9i	$20	Gigabyte B250M-DS3H	$70			2TB	$69	120 GB	$58	SeaSonic M12II ..	$55	Antec GS One	$54
RX 460	$80	R3 1200	$110	Stock	$0	ASRock A320M Pro4	$65	4GB DDR4	$38	1TB	$50	None	$0	EVGA 500B	$49	Corsair 200R	$55
				Gammaxx 40..	$23	MSI B350 PC Mate	$85	8GB DDR4	$65	2TB	$69	120 GB	$58	SeaSonic M12II ..	$55	HAF 912	$60
RX 560	$110	i3 7100	$115	Stock	$0	MSI B250M Pro-VDH	$65	4GB DDR4	$38	1TB	$50	None	$0	EVGA 500B	$49	Corsair 200R	$55
GTX 1050	$115			Gammaxx 40..	$23	ASRock B250M Pro4	$74	8GB DDR4	$65	2TB	$69	120 GB	$58	SeaSonic M12II ..	$55	HAF 912	$60
GTX 1050 Ti	$150	R3 1300X	$130	Stock	$0	MSI B350 PC Mate	$85	8GB DDR4	$65	1TB	$50	None	$0	EVGA 500B	$49	HAF 912	$60
				Gammaxx 40..	$23	ASRock AB350 Pro4	$90			2TB	$69	120 GB	$58	SeaSonic M12II ..	$55	Rosewill Stealt..	$70
RX 570	$170	R5 1400	$150	Gammaxx 40..	$23	MSI B350 PC Mate	$85	8GB DDR4	$65	1TB	$50	None	$0	SeaSonic S12II ..	$50	HAF 912	$60
RX 480	$180	R5 1500X	$180	NH-U12S AM..	$65	ASRock AB350 Pro4	$90			2TB	$69	120 GB	$58	SeaSonic M12II ..	$60	Rosewill Stealt..	$70
GTX 1060 3GB	$190					Gigabyte AB350 Gaming 3	$110			4TB	$135	250 GB	$85	EVGA 650G3	$90	NZXT S340	$70
RX 480	$180	i5 7500	$188	Gammaxx 40..	$23	ASRock Z270 Pro4	$110	8GB DDR4	$65	1TB	$50	250 GB	$85	SeaSonic M12II ..	$60	Rosewill Stealt..	$70

The best way to shop, in our opinion, is to use the following process:

1. Start planning your build by looking at a site like Logical Increments (shown above). It lists a number of builds at different price points, and while you don't need to follow it to the letter---by any means, it'll give you a good idea of what a balanced build will look like at each budget level, which will keep the rest of the process from being too overwhelming.
2. From there, we recommend you start browsing parts at Newegg, even if you don't necessarily plan on buying the parts there. Newegg has fantastic search filters and spec lists that will help you browse for the parts you want. You can start with Logical Increments' base build and swap out certain parts you like better, or start selecting parts from scratch---your call.
3. Once you start gathering parts, plug them into a tool like PCPartPicker. It has a huge database of PC parts and knows which parts are compatible with each other, ensuring you don't accidentally order parts that don't work together. Then, it'll show you which retailers have the best price on each of those parts, so you get the best possible price on the total build.

Logical Increments and PCPartPicker are great tools, but they aren't the only places to do research and make your selections. Here are our favorite free tools for PC builders.

So now you know the basics of what goes into a computer and where to start your shopping. Let's talk about how to select the right parts for the job.

Which Parts Should I Chose?

Here's where a lot of people get tripped up. How powerful does a full-sized desktop need to be? Should you buy an Intel processor or an AMD one? Do you need a graphics card, or will the CPU's onboard graphics be okay? How many watts do you need in a power supply?

Let's break it down piece by piece. Understand that you generally want components that have been released in the last year or two, because going back further tends to trade price for efficiency and future-proofing. And generally speaking, the more expensive a part is, the more powerful it will be.

Processors

Let's start with the brain of your computer: the CPU. This will determine which other parts are compatible, so it's a good place to begin.

AMD or Intel? The first question you'll have to answer is: which brand? These two processor manufacturers have been duking it out for decades. It generally shakes out like this: Intel sells more and has more raw power available at the high end of the market, while AMD competes on price and power efficiency. For example, Intel's latest Core X series processors offer ludicrous amounts of speed and cores for those who can spend well above $500 on processors alone, while AMD's Ryzen series competes on frugality, with savings of several hundred dollars at the same general performance level.

Generally speaking, Intel processors fare better in gaming and high-end media applications due to their raw power and popularity, but if you're on a budget, AMD's general price advantage may be worth choosing the less popular option.

AMD also offers designs that have much more powerful integrated graphics than Intel, referred to as "APU" models. These APU designs can handle light 3D gaming, whereas Intel's integrated graphics aren't generally enough to hack it. They're also great for applications like home theater PCs.

Which Model? Once you decide which brand to go with, it's time to narrow down your processor selection. You might recall that computers used to be advertised based on their processor speed, expressed in megahertz and gigahertz. Those figures are still around, but thanks to advancements in processor design, it's hard to express exactly how powerful a processor is based on a single factor like its clock speed. There are other factors, like how many cores it has, what kind of cache it has, power consumption, and integrated graphics performance (if you aren't using a dedicated graphics card). In layman's terms: more cache and more cores mean better multitasking performance, more pure speed in each core means better single-task performance, like rendering a big image in Photoshop.

Intel's current product line includes four main desktop CPU lines: Core i3, Core i5, Core i7, and the top-line Core i9. There are multiple processors in each line, generally going from least to most expensive and least to most powerful. So for the latest models, the fastest Core i3 processor will be a little slower than the slowest Core i5 model. (Again, there's a lot of variation in composition and architecture, so that may not be true in every single case.)

New models come out yearly, and may or may not need a new motherboard socket depending on the improvements. The "sweet spot" of value and performance is in the Core i5 series; anything less is generally for a budget build, anything more is for an enthusiast build. It's definitely possible to build a powerful gaming PC with a Core i5 instead of a pricier Core i7. Some models have more cores; some have faster cores---gamers and media production pros will want at least a quad-core design, with as much speed as they can get.

AMD's lineup for desktops is more split. The latest conventional designs are called the "Ryzen," available in 3, 5, and 7 models. Processor cores increase as you go up the line and get more expensive CPUs. The top-of-the-line AMD chips are called Ryzen Threadripper, with up to 32 cores. The sweet spot for AMD is in Ryzen 5, either the 4- ore 6-core chips.

AMD's APU models, for more general, less powerful computers, include decent onboard graphics as well. AMD releases new CPUs and socket designs at less frequent intervals. Ryzen, Ryzen Threadripper, and APU chips all use different processor sockets.

If you want to know which processor is faster in direct comparison, you'll need to look at some benchmarks. This list has a huge selection of current and slightly older processors, ranked by benchmark speed with pricing info.

Motherboards

Next, it's time to select a motherboard, the piece that all your other pieces will plug into. It's easier than it sounds, though.

Which Socket? You need to choose a CPU and a motherboard that will fit each other since both Intel and AMD have developed multiple CPU socket designs for different classes of processors. So, can quickly narrow down your selection here by looking for motherboards that are compatible with your processor choice. Check the socket on your chosen CPU---for example, Intel's LGA 1151 socket---and then narrow down your Newegg search to motherboards that contain that socket.

What Size? The motherboard you choose needs to be compatible with the case you're using. We'll talk about this a bit more in the case section below, but the basics are: ATX boards are for standard size tower computers, microATX boards are for slightly smaller towers, and Mini-ITX boards are for more compact builds. These sizes don't necessarily correspond to power---you can have a very budget ATX build, or a very powerful Mini-ITX gaming machine---but your expansion options will be more limited on smaller boards, and they'll be a bit tougher to build with.

What Features? Next, narrow down your search by motherboards that support all the other stuff you want. This generally means at least one PCI-Express slot for a graphics card, enough SATA ports for all your hard drives and DVD drives, support for the amount of RAM you want, and so on. You can find all that information on the specifications page.

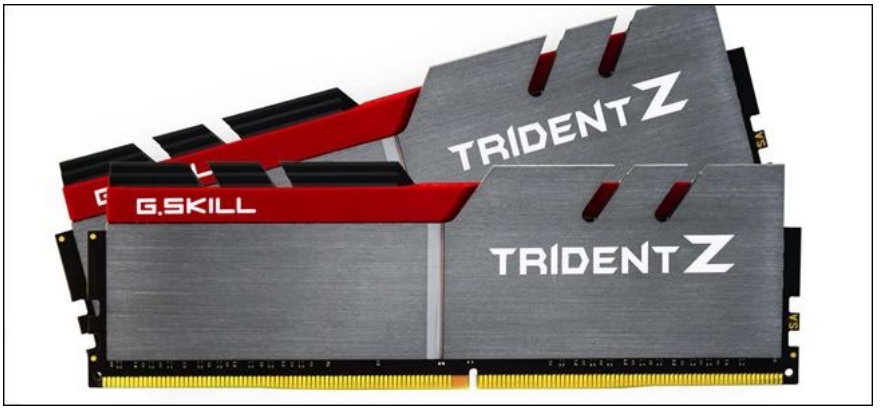
You'll also want to check the back panel, the part of the motherboard where most of your accessories will plug in. If you already have a monitor, keyboard, and mouse, you want to make sure that the motherboard supports them. Most of them will, one way or another, but if for example you have an older monitor without an HDMI port and you don't plan on adding a graphics card, you'll either need a motherboard with a DVI or VGA video port or an adapter.

This brings us to the final part of the motherboard: the extras. As mentioned, most motherboards have support for low-power onboard graphics, as well as basic sound processing (the little headphone jack you plug your speakers into) and an Ethernet port for networking. But some advanced models have support for surround sound output, large arrays of USB 3.0 ports, and even on-board Wi-Fi, so you don't need a separate adapter. Choose with extras you want (if any), and pick the motherboard that has them.

Lastly, the motherboard's cable inputs for power need to match the cables on the power supply, for both the main power connector on the side and the CPU power connector on top. You can check these values in "pins": if your power supply has a 12-pin rail and your motherboard has a 12-pin connector, they're compatible. Depending on the CPU socket, the CPU's power connector may have four, six, or eight pins, so make sure your power supply has one of these rails available.

Recommended brands: ASUS, Gigabyte, MSI, and AsRock are all great brands to look for here.

RAM



Memory is deceptively important: it's the easiest way to turn a slow computer into a fast one. Make sure you get enough.

How Much? For basic modern computing, I suggest at least 8GB, which you can generally get in a 4GBx2 stick setup for under $100. Gamers, media creators, and virtual machine users will want more---the next efficient step up is to 16GB. If you're building a massive system that will do multitasking all day long and handle gigantic games at 4K visual quality, you want every last bit of RAM you can cram into your case (which is usually 32GB or 64GB on today's high-end motherboards.)

Which Type? You need to check your motherboard to see which generation of RAM it supports: DDR3 and DDR4 are the two existing standards right now, and RAM is not backward compatible. The number of slots for RAM on the motherboard and their maximum capacity determines how much RAM you can have in total.

What Speed? You'll also need to choose a RAM speed, which doesn't really produce noticeable performance differences in most builds. But you might as well buy RAM modules that are as fast as your motherboard can handle.

Recommended brands: G-Skill, Corsair, and Crucial are all solid picks.

Storage

Here's a tip for buying storage: get an SSD. No, seriously, get an SSD. A few years ago, solid-state drives were considered something of a luxury, but the speed and efficiency increases are incredible. Now, SSDs are cheap enough that they're becoming standard. Even if you need to store a ton of files, it's such an improvement that I'd recommend buying a smaller, cheaper SSD just for your operating system and programs, and using a secondary hard drive for all your large personal files (music movies, etc.).

Pretty much every new motherboard and power supply will be compatible with current hard drives, solid-state drives, and DVD drives. They all use the same SATA cables and data ports. As long as you don't have more drives than you do SATA ports, you're fine. They also use SATA power rails from the power supply, which should include enough plugs for at least two drives.

Recommended brands: Samsung and SanDisk for SSDs, Western Digital, Seagate, and HGST for hard drives

Cases

Cases are generally just boxes to shove your parts into (*ahem*), but there's a lot of variety to them.

What Size? PC cases are referred to in general terms like "full tower" and "mid-tower," and these will tell you the size and shape of the case---when you think of a normal desktop PC, you probably think of a mid-tower. But PCs also come as bigger and smaller towers, as cubes, or in super-compact, slim designs for your media cabinet.

You'll also want to pay attention to the motherboard size. Motherboards come in several different sizes, but the main ones for consumer class PCs are the full-sized ATX, the smaller Mini-ATX and Micro-ATX, and the positively tiny Mini-ITX. Larger cases will include mounting options for smaller motherboards, so an ATX-sized case can fit a Mini-ITX motherboard, but a Mini-ITX case cannot fit an ATX motherboard.

Everything Else: In addition to size, there's material (steel, plastic, aluminum, acrylic), number of storage and expansion drive bays, mounts for fans and cooling systems, and so on. Aesthetically, most modern cases are either minimalist---basically looking like a tiny, expensive refrigerator---or "gamer," with lots of integrated LEDs and side panel windows so you can see the guts of your masterpiece.

Cases also have standardized mounting areas for the power supply. Most cases will accept a standard ATX power supply, but small Mini-ITX cases may need a Mini-ITX power supply (though some gaming-

branded ITX cases still take a full-sized version). Many smaller cases will even come with their own power supplies to avoid this hassle.

Other factors you'll want to pay attention to are cable management holes, fan and power supply placement for airflow, front panel features like USB 3.0 ports and headphone jacks, and of course your general eye for what you want your computer to look like.

Lastly, if you're going to add a discrete graphics card or CPU cooler to your build, you need to make sure they can fit in the physical dimensions of your case. Some extremely powerful and expensive power supplies might need extra room, so check both the specifications of the GPU itself and the specs of the case to make sure they're compatible. Likewise, a big, boxy CPU cooler might be too physically tall to fit into a smaller case---check the specs for its clearance in inches or millimeters. If you're going for a liquid cooling system with a radiator, you may need to make sure it has adequate space around the case fan mounts, too.

Once you narrow down your selection by size and features, I recommend checking out online reviews of cases that you find on retailer sites. Review sites like Tom's Hardware, PC Gamer, and AnandTech are great places to dig deep into the more esoteric features, but you can find very in-depth reviews with a bit of YouTube searching, too. At the end of the day, what makes a case great isn't always the features you find on a spec sheet---some cases are just much easier and more enjoyable to build in, while others are difficult and frustrating.

Recommended brands: it's hard to find a "bad" case these days---most manufacturers seem to have the building and ergonomics down to a science. I prefer cases from Fractal Design and Antec, but Corsair, NZXT, and Cooler Master are all popular brands with lots of cases. But they aren't the only ones, so feel free to shop around.

Power Supply

Your power supply supplies electricity to every component of your PC, so you want one powerful enough for your build---and reliable enough for safe, efficient operation. Power supply selection is a lot more important than it seems on the surface.

How Many Watts? You don't want the total electricity used by those components to be more than it can convert. The biggest draws here will be your motherboard, CPU, and graphics card. Other components, like the case fans and the storage drives, use so little electricity that you can usually fit them into the margins of your calculations.

The total power draw of your combined components determines how much capacity your power supply needs, in watts. For example, the NVIDIA GTX 1080 TI, a very powerful graphics card, requests a power supply of at least 600 watts in its specifications (and both an 8-pin and 6-pin power rail---see the graphics card compatibility section). The GT 950, a much less powerful card, needs only 150 watts.

If you're not sure exactly how much power you need for your system, use this handy calculator. Just put in the specifications of the components you've selected, and it will tell you how many watts your power supply will need. Again, you'll still need to make sure that the power supply's rails match the sockets on your motherboard, graphics card (if you have one), SATA drives, and other components.

Modular, Semi-Modular or Fixed: Some power supplies have their cables (or "rails") permanently attached, so you have to stuff the excess wherever you can---even if you aren't using certain rails at all. A modular or semi-modular power supply, on the other hand, allows all or some of the power rails to be unplugged from the supply itself. This is an extremely handy upgrade, especially if you'll be working on a case

with cramped quarters or a lot of components. If your budget stretches, go for the upgrade over a non-modular model.

Left to right: standard with all-fixed cables, semi-modular with fixed cables for the most commonly-used components and removable cables for accessories, and fully modular with removable cables for everything.

Efficiency and Quality: When you shop for a power supply, you'll often see a little badge indicating how efficient it is. It'll usually say something like 80 Plus, 80 Plus Bronze, 80 Plus Silver, 80 Plus Gold, or 80 Plus Platinum. The higher the badge, the more efficient the power supply will be, the less noise it'll produce, and the less you'll pay in wasted electricity.

Lastly, you're dealing with electricity here, so you must get a safe, well-built power supply. If you get a cheap, poorly-built model, you're asking for trouble. At best, it'll fail early and be unable to power your PC. At worst, it could harm your parts or even be a fire hazard. Instead of reading user reviews, we highly recommend going to a reputable site like JonnyGURU.com, which is known for its in-depth testing of power supplies for quality. Search for the power supply you're interested in, and if it gives the thumbs up, you know you're in a good spot.

Note that some cases may come with power supplies, but in most cases, they are not high-quality ones we'd recommend. This is not the place to skimp, guys: buy a decent power supply.

Recommended brands: Corsair, EVGA, and Cooler Master are a few good ones, but there are many others. But just because a brand is good doesn't mean you shouldn't do your homework---sometimes good brands can make a low-quality PSU, so check those expert reviews before you buy.

Graphics Card

This is a complicated and contentious choice, but if you're looking to do some gaming, it's one of the most important choices you'll make in terms of performance.

Which Chipset Brand? Like processors, discrete graphics cards come in two primary flavors: NVIDIA and AMD (yes, the same AMD as before---they bought NVIDIA's rival ATI years ago). NVIDIA tends to lead in pure technical power, and AMD typically competes on value, although this can ebb and flow at different times. NVIDIA also has technologies like GameStream that may be worth paying extra to you.

Which Manufacturer? There's another layer of complication here: NVIDIA and AMD don't build their own graphics cards (most of the time), they license their GPU chips out to other companies who then construct and sell the cards under their own brands. So you can buy an NVIDIA GTX 1050 card from ASUS, EVGA, or Zotac, all using the same NVIDIA processor with very slight variations in the circuit board, RAM, cooler, monitor connections, and other parts. Start with which graphics chip you want, then figure out which manufacturer has the card with the features you need.

How Much Power? The card you get depends on what you want to do. Even if you're looking for high-end gaming, you probably don't need to spend as much as you think. There's an enormous selection of cards from a ton of different companies at all different price points, but a very brief breakdown goes something like this:

- No gaming at all: use the integrated graphics on the motherboard. It's free!
- Very light gaming, with older titles or 2D titles: it's still probably okay to use integrated graphics here.

- Simple 3D games like *World of Warcraft* and *League of Legends*: $100 cards or less.
- Intermediate games like *Overwatch* and *Team Fortress 2*: $100-200 cards.
- New AAA games like *Call of Duty* and *Assassin's Creed* at up to 1080p resolution and medium settings: $200-300 cards.
- New AAA games at high settings or resolution higher than 1080p: $300-400 cards.
- Super-high-end games at high settings and ultrawide or 4K resolution: $400 and above.

Look at benchmarks, especially for the games you want to play, to see which cards are going to be the best in your budget.

Lastly, make sure the card you buy can get enough power from your PC. Most mid-range and all high-end graphics cards need a dedicated electrical connection to the power supply, in addition to being mounted on the motherboard. You'll need to make sure that your power supply has enough rails and the right connection to support it. Check the specifications: most require either a 6-pin rail, an 8-pin rail, or multiples of both. The GPU also draws electrical power at a rate that shouldn't exceed your power supply's capacity.

Recommended brands: You can't go wrong with EVGA, ASUS, GIGABYTE, MSI, and XFX.

CPU Coolers

If you want to add an aftermarket cooler to your CPU---which you more or less only need if you're planning on overclocking it---we recommend Cooler Master, Noctua, or (if you want a liquid cooler) Corsair. For compatibility, make sure it supports your CPU's socket and that it can fit into your case---the specifications will list its height from the motherboard up.

Everything Else

Most of the other stuff you can buy for the inside of your PC will connect to and draw power directly from the motherboard, like PCI-E expansion slots or add-ons that use the front drive bays. Just make sure you have enough connections and space to supply them, and you're fine. The only real exception is case fans, which can plug into either the motherboard or directly to the power supply.

Double, Triple, and Quadruple Check Your Parts for Compatibility!

Your needs for each component will vary based on the kind of computer you want to build and your budget. You can find help for selecting the right graphics card or RAM with a Google search but this article is all about choosing components that are compatible with each other. Before you make your final purchases, make this last check for compatibility, checking each part against each corresponding part in sequence.

- **Processor**: needs to match your motherboard's CPU socket
- **Motherboard**: needs to be compatible with your processor, RAM, and power supply (correct number of pins for motherboard rail and CPU rail)
- **RAM**: needs to match the number and type slots on the motherboard (DDR3 or DDR4)
- **Storage**: needs to fit in your case (enough storage bays in the right sizes?), and your motherboard needs to have enough SATA ports
- **Case**: needs to fit your motherboard, power supply, CPU cooler, and number of storage drives,
- **Graphics card**: your motherboard needs the right type of PCIe slot to hold it, it needs to fit the size of your case, and needs the right connector on your power supply
- **CPU cooler**: needs to fit your motherboard/CPU socket and fit inside your case
- **Case**: needs to fit your motherboard (can it accept the right ATX or ITX mounts?), power supply (is the bay big enough?), graphics card (is it too long to fit?), and CPU cooler (is it too tall to fit?)
- **Power supply**: needs the right overall electrical capacity for your build, needs the correct number of pins on motherboard and CPU rail and needs enough extra rails for a graphics card, storage drives, and other power-drawing extras

That may seem daunting, but again, a site like PCPartPicker can do most of the heavy lifting for you—then you can just double-check the spec sheet and make sure everything matches up.

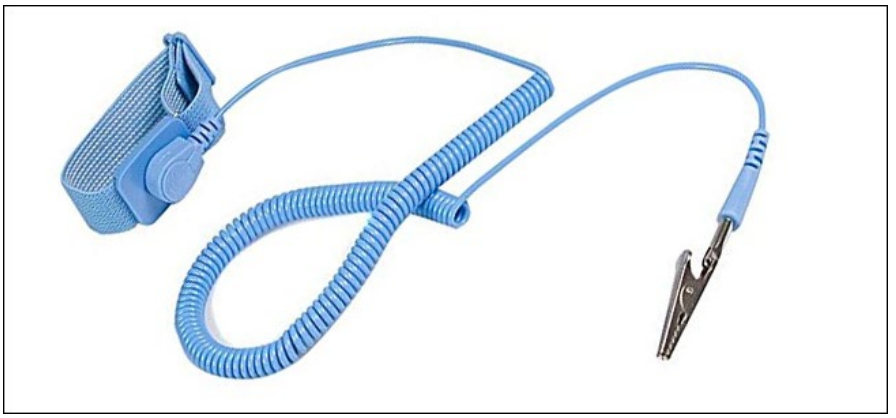
Part Two: Putting It Together

So you've selected your parts, double- and triple-checked their compatibility, and waited for economy shipping to bring them all to your door. It's time to get to the fun part: putting them all together.

Before you start, you'll want to set up a good work area. Get a table with plenty of room and light, preferably somewhere that isn't carpeted. And you'll need some time: a couple of hours, maybe more if this is your first time or if you have a lot of extras.

The Tools You'll Need

All you should need for the assembly process is a Philips-head screwdriver. A nice set of bits is handy for larger or smaller screws, but everything else you need should be provided with your case and various parts.



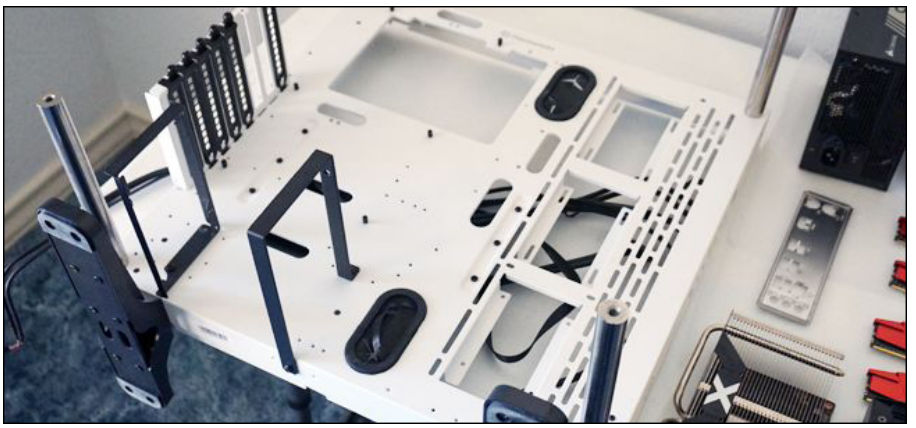
If your home or your workspace is particularly prone to static discharges, you might want an anti-static bracelet. This doohicky clips to a piece of metal (like the PC case) to electrically ground your hands

while you're working, protecting your parts from a discharge. It's very rare that a static shock will actually damage a PC part, and you'll probably be okay just using the anti-static bags that come with your motherboard and graphics card. But if you want to be extra cautious, it couldn't hurt.

Finally, you might want to add a couple of cups or bowls from your kitchen, just for a place to put loose screws. (Or, if you have one, a magnetic parts tray is wonderful.)

First: Examine Your Case

First, take a look at your case. You'll be able to spot the main compartment that holds the motherboard, the drive bays for hard drives and SSDs, the openings in the back for the motherboard's ports and the expansion bays for graphics cards, etc. You should have a pretty good idea where everything's going to go already---if you're not sure, check the manual that came with it (or download it off the support web page on your phone. Remove both side panels while you're at it because you'll need access to the inside from both sides as you build.



You might notice that the PC case we're using in these photos looks a little strange. It's a Thermaltake P3 enclosure, an open-air design with an acrylic cover, designed to show off all the components and not require any case fans. We chose it specifically so you could see the components clearly in these photos, but it doesn't have exactly the same configuration as most box-style enclosures. Just imagine it with walls on an extra five sides.

Step One: Install the CPU

We're going to install the CPU and the RAM onto the motherboard before installing the motherboard itself because it's easier than installing them once the board is fixed in place. Take your motherboard out, put it on top of the box it came in, and you'll have a nice little static-free test bench to perform these steps.

Installing the CPU used to be a bit of a nerve-wracking process, but it's become much easier as the designs have streamlined. Just try not to touch the electrical contacts on the bottom of the chip, and you'll do fine.

The CPU will be in a plastic case or some other protector when you take it out of its box. Keep it in there for the moment and take a look at the CPU socket on your motherboard---it's that open area in the upper-left corner on almost all motherboard designs. There should be a plate that swivels up and down on a hinge (on Intel boards), and a lever that can be pressed down and clipped into the motherboard for safety (on Intel and AMD boards). Take a second to see how this mechanism works on your specific model---they vary a bit between processors and manufacturers.

Raise the plate, then take the CPU out of its protector. Look closely at the top and bottom (without touching the electrical contacts) and see how they line up in the socket. Most CPUs also have a small arrow in the corner---in the photo below, it's on the bottom left of the chip. This will correspond to a similar arrow in the socket, so just line them up.

When you're sure that you know which way the CPU fits into its socket, gently slip it in. You should be able to let it go, and it will simply fall the last millimeter or two. It should be flush with the walls of the socket. Now drop the plate, if there is one---if you can't push it down all the way, stop, your CPU isn't inserted correctly. Go back to the start of this section and start over.

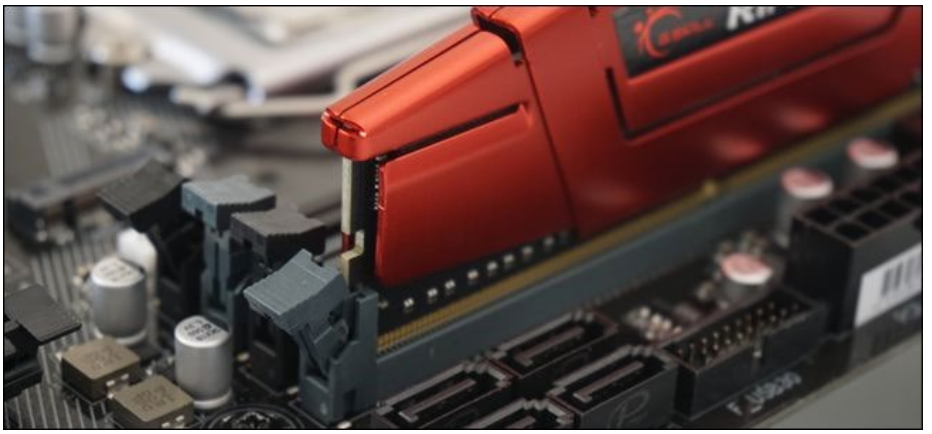
If you can lower the plate all the way, great. Press the lever down beneath the safety tab. You're ready to go on.

Step Two: Install the RAM

Next, it's time to install the memory modules. You'll want to do this before installing the CPU cooler, since some aftermarket ones will hang over the edge of the RAM, making it difficult or impossible to put them in after the fact.

The RAM slots are the long, shallow slots with clips on both sides, usually to the right of the processor from your current perspective. Smaller boards might have only two, larger and more expensive boards can have as many as eight. We're going to be inserting four RAM sticks (DIMMs) in our build.

Look at your DIMM and its corresponding slot. There's only one way it will fit—line up the notch in the middle of the gold contacts with the plastic bump in the slot. This should work no matter what generation of RAM you're using: DDR3, DDR4, or something even newer. If for some reason your RAM won't fit, it's probably incompatible with your motherboard.



If you're ready to install the RAM, fold the clips on the top and bottom of the slot down. Put the RAM in, contact-first, and press down firmly. The clips should snap back into place to secure the DIMM. Press down on the RAM at the top and bottom to be sure.

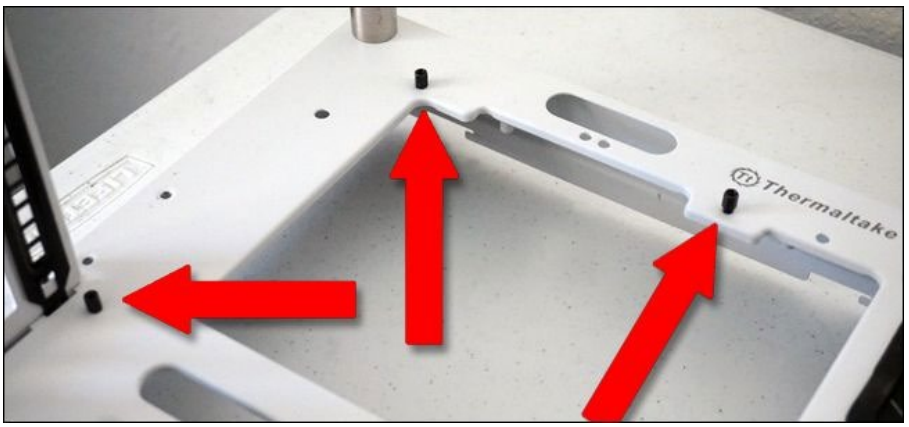
Repeat the process for all the RAM modules you have. If all of them aren't parallel, push down until they are.

If you have fewer RAM modules than you do RAM slots, pay attention to which ones you fill up. Notice how the slots in the photos above alternate colors---black and gray? That's because of the way they're designed to work with memory channels going to the processor. In short, use ONLY the black or ONLY the grey slots if you're not filling them up---substituting the colors for whatever your motherboard uses, of course.

Step Three: Install the Motherboard

Set your case down on the table, with the front panel on your right side. Remove the case's access door and look down. That large slab of steel or aluminum is where you're going to install your motherboard, and by association, a large portion of the pieces you've bought.

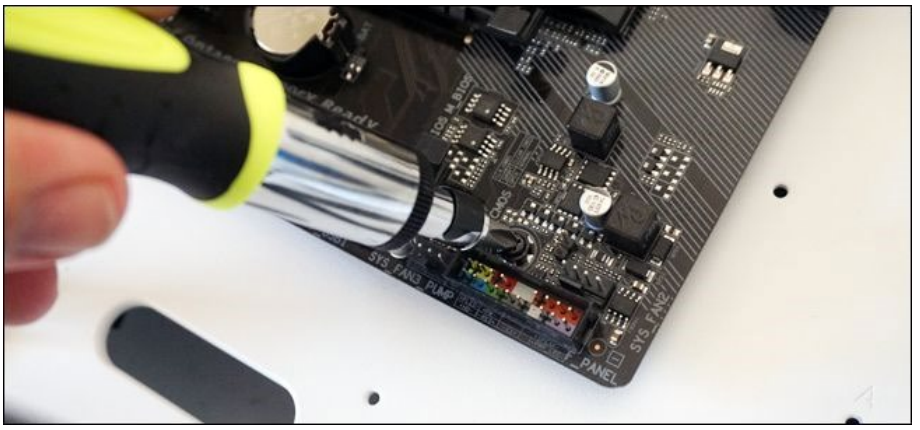
The first thing you'll want to do is install the motherboard risers, small brackets that separate the motherboard from the case itself. Our ATX-standard motherboard uses six. They should be included in the box your motherboard came with or the box your case came with---if it's not clear from looking at it, take a quick look at the manual. You should be able to screw the risers into their mounting holes with just your fingers; they'll tighten in further when you screw the motherboard in place.



NOTE: Some cases don't have a big cutout near the top of where the motherboard goes, like the one in the picture above. If you're installing an aftermarket cooler, and your case doesn't have this cutout, you'll want to install the cooler *before* putting the motherboard in---so skip down to that section now, and then come back here. Stock coolers do not require this.

Before you place the motherboard itself in the case, install the I/O plate. This is a little piece of aluminum that fits in the back of the case, with cutouts for all of the ports on the back of the motherboard (to the left, from where you're looking now). You should be able to slip it in and click it into place without any tools, though it may take a little force. Our open-air case doesn't have a place for the rear I/O plate, so here's what it looks like most of the time:

Now, take the screws that came with your motherboard and tighten them down into the risers with your screwdriver. Make them good and tight, but not so tight that they crack the circuit board. Make sure to use every screw for every riser: these are the only things that will hold up the motherboard, and all the parts connected to it.



When you're finished, your motherboard will be sitting on the risers about a quarter-inch above the frame of the case.

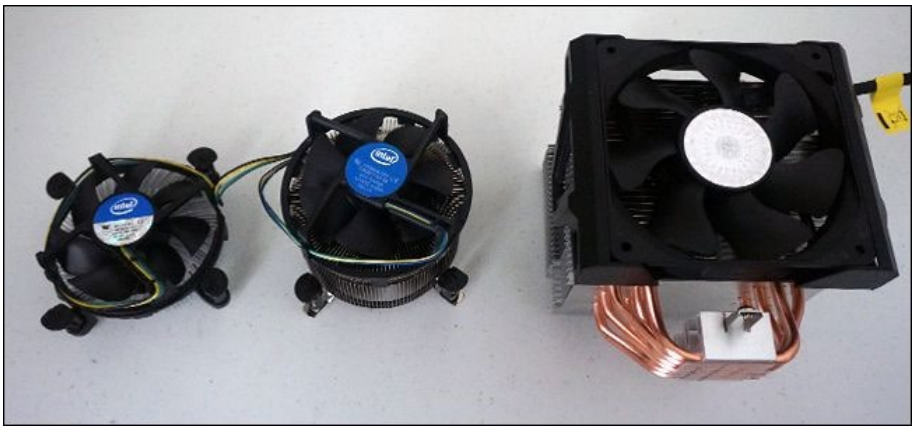
Make sure the I/O plate fits flush with the case and the various ports on the motherboard, bending back the metal prongs if necessary.

Step Four: Install the Case Fans (If Applicable)

Next, install the case fans in the front, rear, or sides of the computer. (If they're already pre-installed in your case, you can skip this step.) Install them now so that you don't have to worry about the components getting in the way later. Most of the time you'll screw the fans directly into the case, but some gaming-branded cases may have fan caddies or sleds for easy removal and cleaning. Your case manual may have more information.

Keep in mind that where you place your fans---and which direction they face---matters. If you're not sure how you should configure the fans for the best airflow, check out this guide.

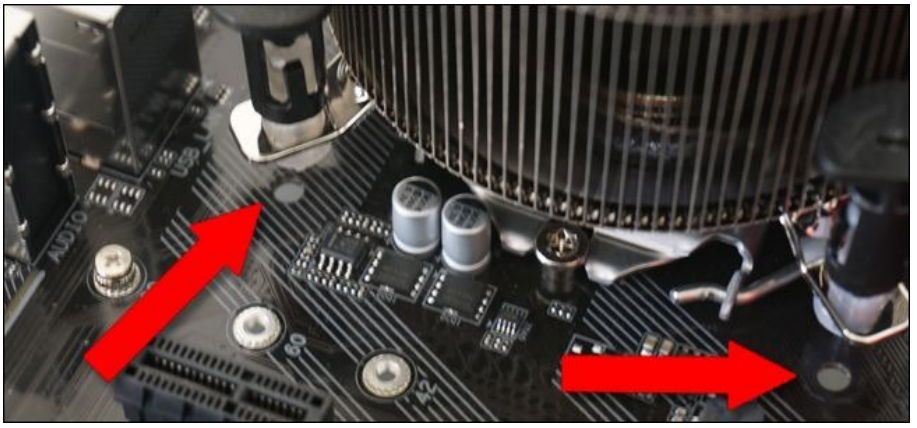
Step Five: Install the CPU Cooler



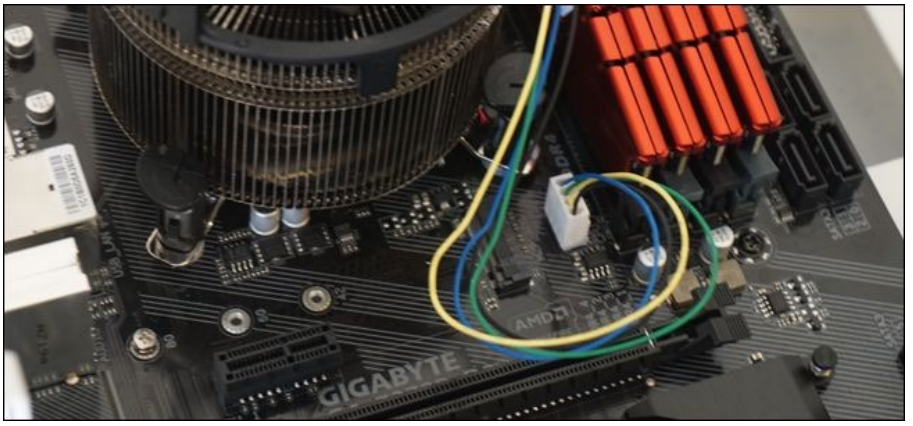
If you're using the cooler that came with your processor, this will be easy. The coolers that come with CPUs include thermal paste pre-applied to the contact, as do some aftermarket ones, making the process even simpler. Aftermarket coolers can range from easy to oh-god-why difficult, but we'll walk you through what we can in that realm too.

The Stock Intel Cooler

There are four mounting holes a few millimeters on all four corners of the CPU socket. Just push down on the cooler and screw them in place---on the stock Intel cooler, the screws are plastic and mounted on springs, you shouldn't even need any tools.

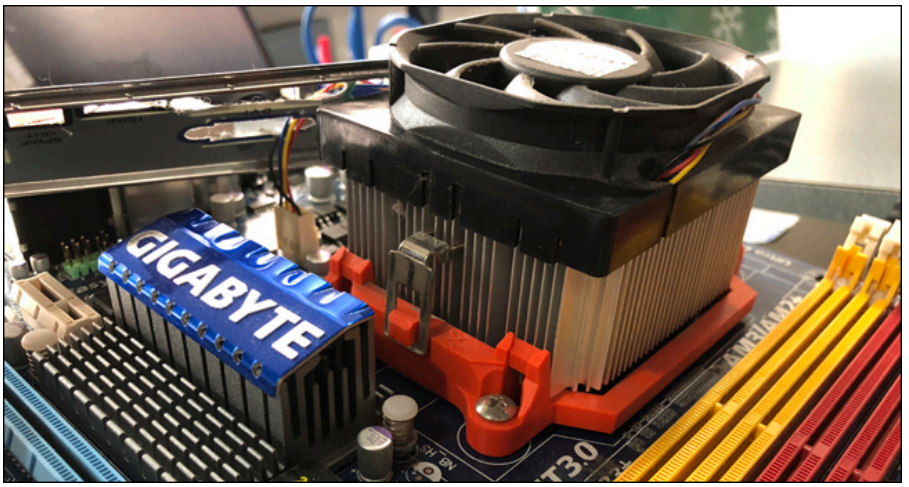


One the cooler is in place and secure, you'll need to plug its power cable in. There's a small three- or four-pin power port on the motherboard, very close to the CPU socket. Plug it in with the short cable to power the cooler's fan.



The Stock AMD Cooler (and Some Aftermarket Ones)

AMD motherboards come with two plastic pieces on either side of the CPU, and the AMD stock cooler will hook onto these (as will some aftermarket ones). Line up the square metal hooks on the heatsink with the plastic notches on the motherboard, then press the lever down to lock it in place.

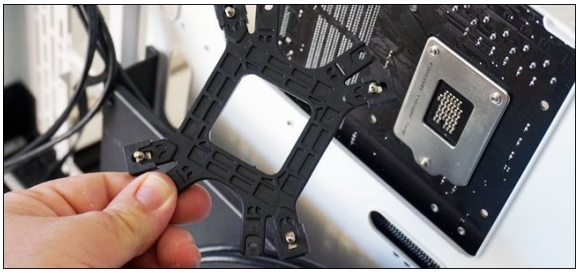


Some heatsinks may require you to screw down the hooks instead of pressing down a lever, but all of them will lock on with some variation on this method.

Large Aftermarket Coolers (for Both Intel and AMD)

If you're installing an aftermarket cooler on an Intel chip (or some AMD chips, depending on the cooler), the process is considerably more complicated. This final type of cooler contains a backplate and requires you to screw the cooler on using four mounting holes on the motherboard. (If you're using an AMD board, you'll have to remove the plastic pieces to gain access to these holes.)

To attach the backplate, stand the case up vertically and remove the rear panel to get access to the bottom of the motherboard.



Assemble the backplate for the larger cooler. This is required because of the larger size and weight of these coolers: they need to have a more secure footing to avoid warping the motherboard.

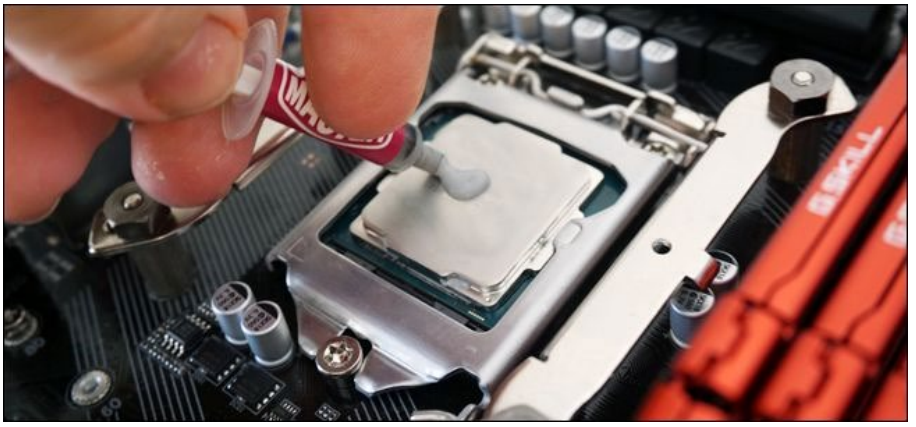
Most aftermarket coolers have separate instructions and parts for various Intel and AMD sockets; this one required me to put screws into specific tabs and set them up for the LGA 1151-series CPU socket.

With the backplate in place, move the case around so that you're once again facing the "top" of the motherboard. Install the risers on the screws coming up from the cooler mounting plate. You may need to "hug" the case to hold the mounting plate steady while you screw down the risers with your other hand.

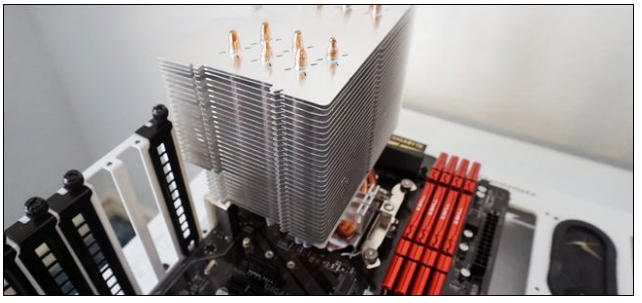
With the plate securely in place and the risers set, lay your case down once again in its original work position, with the front panel on your right side. Leave the rear panel removed; it will save you time later.

Continue to follow the instructions to install your specific cooler. In our case, that included screwing down these steel brackets and securing them with nuts and the included wrench, then installing a retention screw for the cooler itself.

Before you set the cooler in place, you'll need to apply thermal paste to the top of the CPU. There are a lot of different opinions about the proper technique here, but the easiest and most reliable way to go about it is "just put a pea-sized drop in the middle."



With the paste in place, set the cooler down and secure it to the mounting bracket; with our model that means clipping it in on one side and screwing it down on the other.



Finally, attach the fan onto the cooling fins (this may already be done for some coolers).

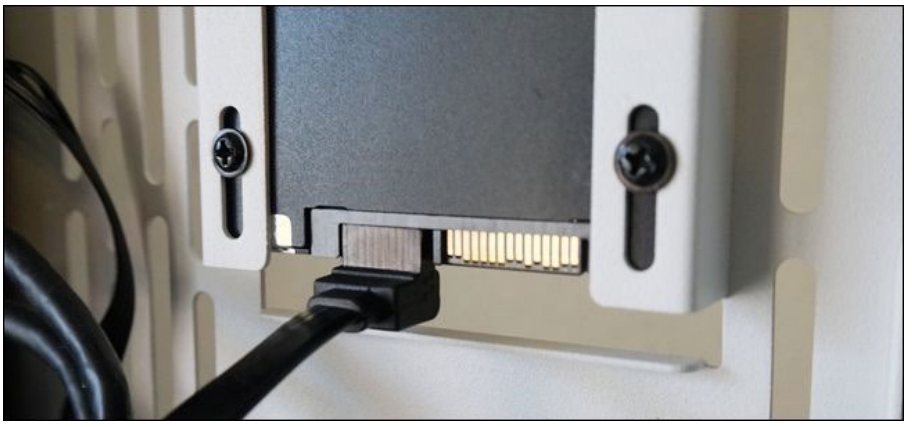
When you're done, plug the fan into the motherboard, using the same three- or four-pin power port used by the stock cooler.

Step Six: Install the Storage and Optical Drives

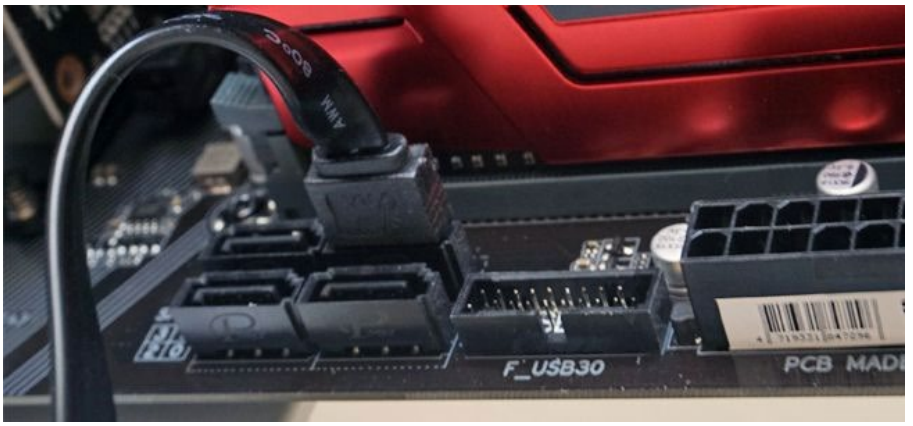
Our basic machine has only one small SSD for storage, but whatever form of storage you're using, it's pretty simple to get it installed. Your case will have either permanent mounting locations (like ours, right on the side) or sliding caddies that let you screw in the drive and then slide it into a slot for easy removal and replacement. Either your case or your drive itself should include screws to secure it in place. Check your case's instruction manual if it's not immediately obvious where your storage drives should go.

Our SSD drive goes in a little groove on the side of the case. I raised the case to the vertical position again, then inserted and tightened the screws from the back. Easy peasy. (The case also has larger brackets for optional 3.5-inch hard drives, which we're not using.)

Once your storage drive is in place, connect the SATA data cable to the SATA port on both the drive. There's only one way the cable can fit, and it's the same connection on both sides.



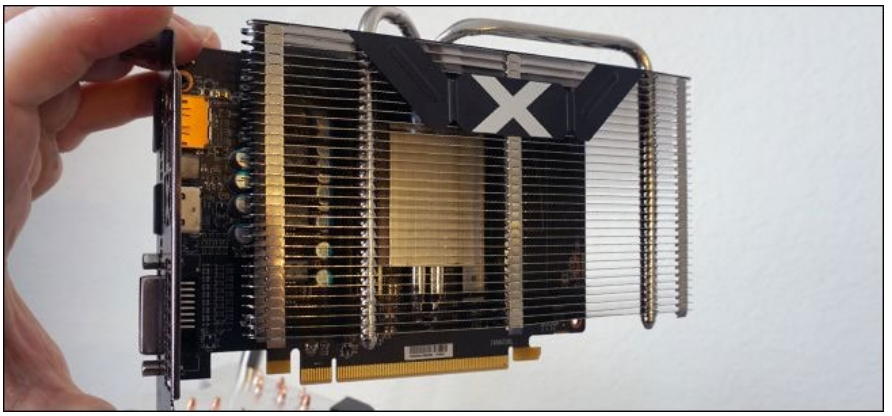
Then, plug that same cable into the SATA port on the motherboard. Repeat this process for as many SSDs or hard drives as you're planning to use.



Installing a DVD drive, if you have one, is also pretty simple. On cheaper, simpler cases, slide it into place in the large 5.25" bay at the front and screw it down with the included screws. More elaborate cases have only one more step: screw in the runners on the side of the drive, then slide the drive into place. Like the caddies for SSDs and hard drives, this makes it easier to replace the drive.

In either case, plug the SATA data cable into the drive and the motherboard, just like you did for the hard drive, and you're ready to go.

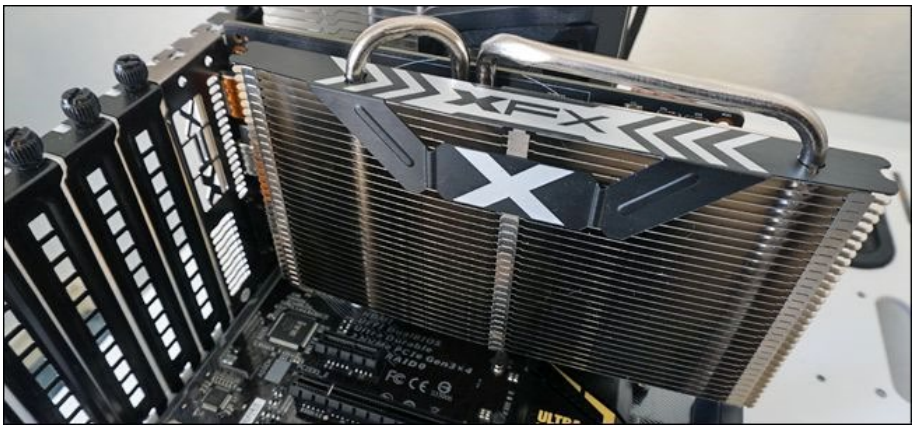
Step Seven: Install the Graphics Card (and other PCI-e Accessories)



If you're using a discrete graphics card for gaming, you'll want to install it now. It uses a PCI-Express (PCI-e, PCIe, PCI) slot, which opens to the outside of the case for expansion ports and is almost always found beneath the CPU socket on the motherboard.

First, determine which of your PCI-e ports uses the x16 speed lanes. It should have PCIEX1_16 or a similar designation: it will be the slot closest to the CPU and the longest (or tied for the longest). If this stuff is confusing, check out this article on using the right PCI-E accessories in the right slots.

Now remove the rear cover for that slot (or slots, if your card is big enough that it needs to have two of them removed). These little metal or plastic pieces are just there to protect your computer's insides for PCI-E slots that aren't being used. Now lower the plastic tab at the end of the slot---this works a lot like the RAM modules, but only on one side. Slide the graphics card in, starting with the side closest to the outside of the case. Press firmly down until the tab locks into place.



Then, put the thumbscrews back in where they came from, securing the card in place.

Step Eight: Install the Power Supply

You're getting close to the end here. Slide the power supply into its bay or bracket. The part that accepts the three-prong power cable (the one that plugs into the wall) should be flush with the back of the case, and accessible from the outside.

Depending on the design of your case, you may want to mount it so that the fan is facing either up or down. Most people like to have the fans facing outside the case (fan up if the power supply is at the top of the case, fan down if it's at the bottom), as this will let your power supply take in cooler air. But to be honest, it doesn't make a huge amount of difference---your power supply won't overheat unless you chose one that's insufficient for your computer. If it's easier to access components the other way, that's fine, as long as there's a bit of clearance between the fan and the closest non-mesh surface.

Different cases have different spots to secure the power supply in place, but generally, you're going to be using at least four screws. Sometimes you may need to screw the supply in place via the holes on the outside of the case.

When the power supply is firmly in place, it's time to plug it in all of the components that need power from it. Remember that you can run the cables through more or less any hole, and it might be best to use the back of the case to keep things from getting tangled or catching on the fans.

From biggest to smallest:

- **Motherboard**: 24-pin cable (sometimes more). This is usually on the right-hand side of the motherboard in its mounted position. Look at the pattern of the plastic molding around the pins: there's only one way it will fit.

- **CPU**: 4, 6, or 8-pin cable (sometimes more). This port is also on the motherboard, but it's somewhere near the CPU socket, often at the top left. Again, there should only be one way to plug this in.

- **Storage drives and DVD drives**: SATA power cables (the ones with the L-shaped connectors). Most modern power supplies will include at least one SATA power cable, often with sockets for multiple drives that you can use at the same time.

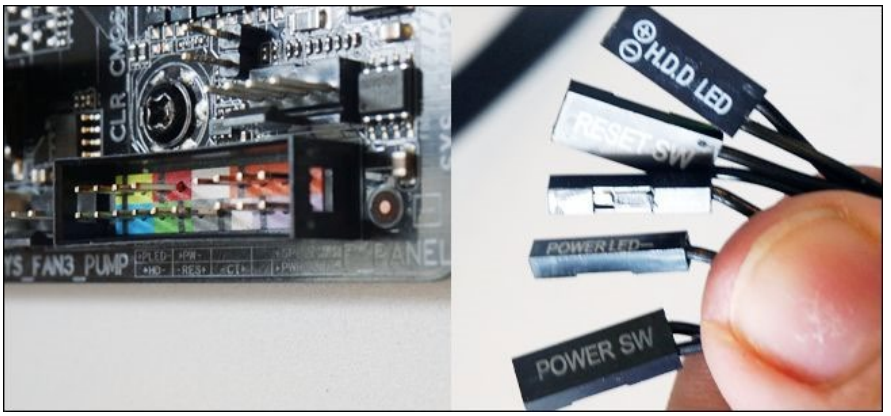
- **Graphics card**: 6, 8, 12, or 14-pin cable, depending on how powerful the card is. (Ours is a low-power model that gets all of its electrical power from the motherboard, and it doesn't need a direct connection to the power supply). For very powerful cards, you may need to use multiple power cables for a split connection, but again, each cable should only be able to fit one way.

- **Case fans, coolers, and radiators**: Connect the cooling equipment to the power supply with whatever it needs. Some fans with a four-pin connector can attach directly to the motherboard, but others need to be plugged into a power supply rail. You may need Molex adapters or SATA adapters if you have more than two or three fans, but generally, the power supply comes with enough extra cables for most basic builds.

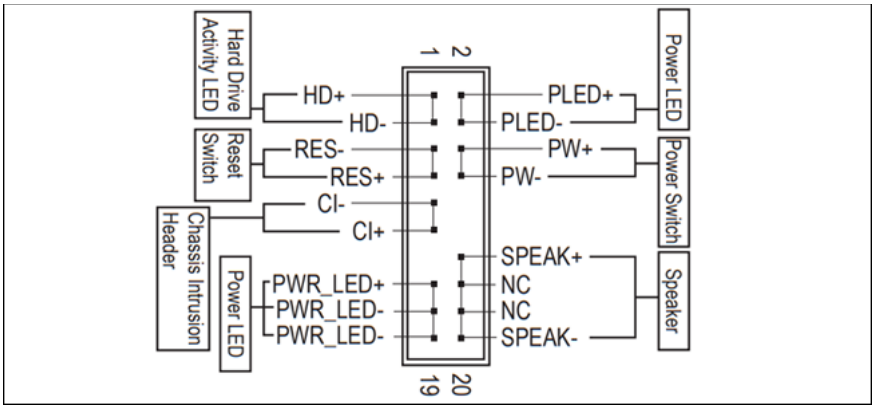
Anything else you're likely to install should be able to draw its power directly from its connection to the motherboard.

Step Nine: Plug in the Case Controls, Audio, and USB cables

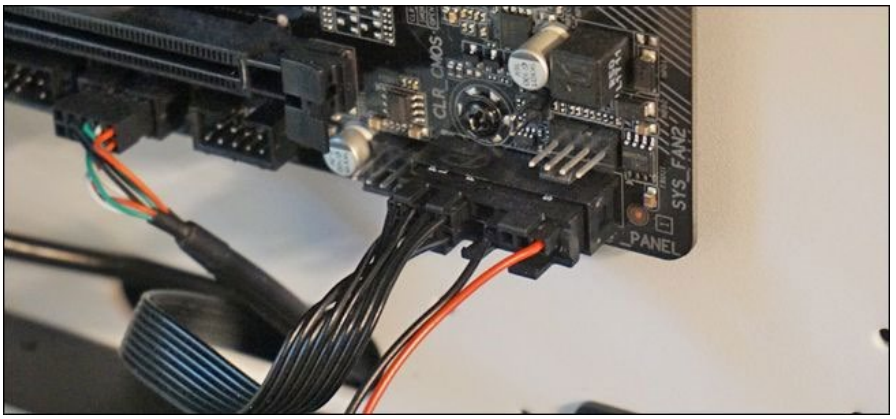
The last things you'll need to plug in are the cables for your case---these connect the power and reset buttons, the front-mounted headphone and microphone jacks, and any USB ports on the front of the case to the motherboard.



The power buttons and lights are the trickiest here because they're really tiny electrical cables that have to plug into very specific pins on the motherboard's I/O panel. This panel is usually at the bottom-right of the board. Depending on how your case is laid out, you'll definitely have a two-pin power cable, a two-pin cable for the light that shows you the computer's on, and possibly a two-pin reset cable and a two-pin "HD," "IDE LED," or "Drive" cable (for the little light that blinks whenever your computer is accessing its storage drive). Some or all of these might be broken into positive and negative connectors.

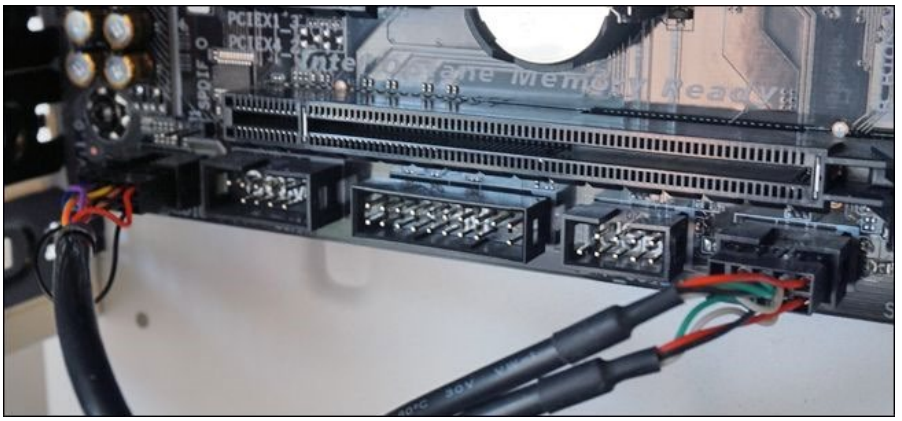


This is the connection diagram for the I/O panel on our motherboard, from the manual. Yours will be different.



These get frustrating because they're tiny and hard to read. It's best to break out your motherboard's manual and look for specific instructions on the I/O panel. Our motherboard came with a handy little plastic piece that was pre-labeled, and our case has nice bright white labels on the cable itself, making the whole process fairly obvious. Double-check these connections with the motherboard manual if you're not sure about them: you need the power button to be right at the very least if you want your PC to turn on!

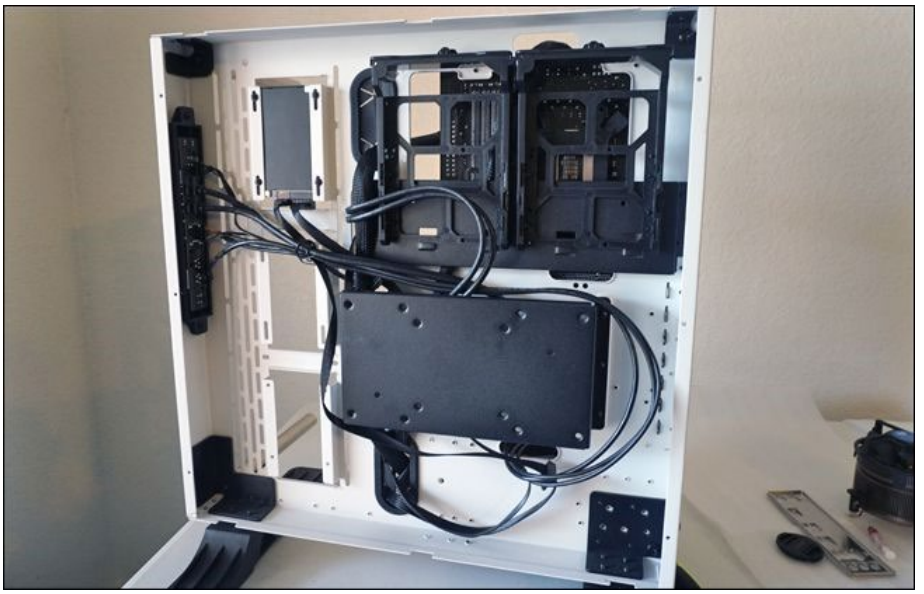
The USB and audio connections are more obvious: they'll plug into specific sockets on the motherboard, usually labeled as such. Our case has one for the USB 2.0 ports, another and another similar-looking one for the audio jacks, both of which plug into the bottom of the motherboard.



The bigger plastic cable for the USB 3.0 jacks goes in the side. Again, if you can't find the specific plugs for your motherboard, consult the manual---it should have a diagram either of the parts of the whole board or the specific locations of the connections for the case's front buttons and inputs.

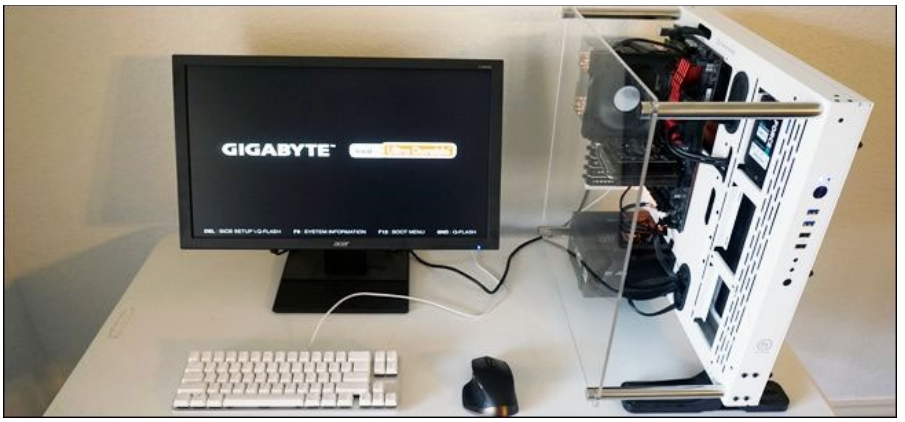
Wrap It All Up!

You're nearly done. Before you close up your case, double-check to make sure none of the power or data cables are too close to one of the case or cooler fans, and that everything is firmly in place and locked down. Looks good? Then put the front and rear covers on and secure them in place with the thumbscrews.



You can use the area behind the motherboard to hide excess cable lengths, keeping them from tangling or touching the case fans.

Connect the power cable to the power supply, then your monitor, keyboard, and mouse. Press the power switch. If you can see the power indicator light on the case, hear the case fans, and see the motherboard logo (known as the POST screen), you're all ready to install your operating system. Congratulations, you've successfully assembled your PC!

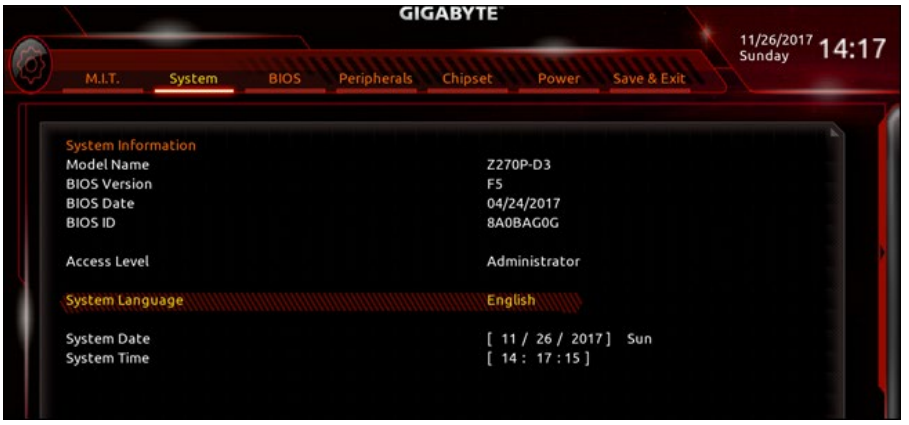


If for some reason the power didn't come on, unplug the PC and the accessories, then double-check these common problems:

- Did you have the power switch on the power supply in the right position? This is the switch accessible from the outside of the case; the "I" should be down, and the "O" should be up.
- Did you plug the power cable from the power supply into the CPU power socket on the motherboard? This is the smaller of the two cables going from the power supply to the motherboard, usually somewhere near the CPU socket at the top of the board.
- Are all the RAM sticks securely in place, with the plastic clips clamped down?
- Is the CPU cooler connected to the motherboard for power?
- If you're using a graphics card, did you plug the monitor cable into the card instead of the video-out port on the motherboard?
- If you're using a graphics card, did you plug it into the PCI-E slot on the motherboard firmly, with the plastic clip clamped down? Did you use the correct power cable to connect it to the power supply (if it needs one)?
- Did you have the case's power switch cable in the right pins on the motherboard's I/O panel?

Once your system POSTs properly, it's time to prepare your BIOS and install your operating system.

Part Three: Getting the BIOS Ready



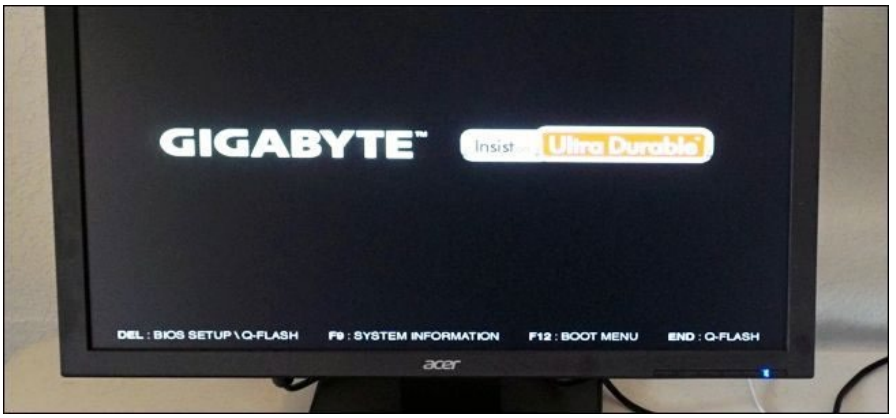
So you've carefully picked out some parts and built a computer, but it doesn't do anything...yet. Before we hop into installing your operating system, we need to take a quick look at the BIOS and prepare it for our operating system.

BIOS stands for "Basic Input-Output System." It's a tiny program that's stored on a small memory chip in your motherboard, and it runs on your computer before the operating system does, setting everything up and allowing you to change basic settings. It's what allows you to install a new operating system, overwrite an old one, or do more technical stuff like overclock your processor.

(Technically, most new motherboards including ours are loaded with a more advanced kind of pre-boot environment called a Unified Extensible Firmware Interface (UEFI). It has a ton of new and useful features to support modern hardware. But everyone still calls it "the BIOS," because it covers all of the same bases.)

Getting Into the BIOS

If you don't have an operating system installed on your storage drive, the UEFI/BIOS program should start immediately when you turn your computer on. If it doesn't, take a look at the splash screen (the one with your motherboard's logo or text): it will have directions on how to start it.



Usually, you do this by quickly pressing F1, F2, F11, F12, Delete, or some other secondary key on your keyboard as it boots. (On our Gigabyte keyboard, the command is "Delete," in the lower-left portion of the screen above.) If you don't get it on the first try, turn the computer off and give it another go.

Once you're in, there are a few things you may want to do.

Update Your BIOS or UEFI (Optional)

Chances are, your motherboard is not running the latest version of its UEFI. Updating it helps to support new features, patch bugs and security vulnerabilities, and generally give the place a bit of spit-and-polish. Because the UEFI runs before the full operating system, it doesn't have a way to update itself over the Internet, and you'll need to do it manually.

Note that you don't generally *need* the latest version of the motherboard firmware unless you run into specific compatibility problems with newer hardware and features. For example, if you have a last-generation motherboard and a current-generation CPU that happens to use the same socket, you may need to update it for the CPU to work properly. Updating is also sometimes recommended for specific, critical security updates or bugs.

You can check for the latest version of your UEFI/BIOS by putting the model number into Google and adding "BIOS update." (Check the box or one of the UEFI menus if you don't know your motherboard model.) On your manufacturer's product page, you'll find a list of updates, usually under "Support." Download the latest one if your UEFI isn't already running it.

Again, for each manufacturer, this process is a little different, but all of them should have some means of updating the UEFI program without an operating system installed. In the case of our Gigabyte motherboard, the process went something like this:

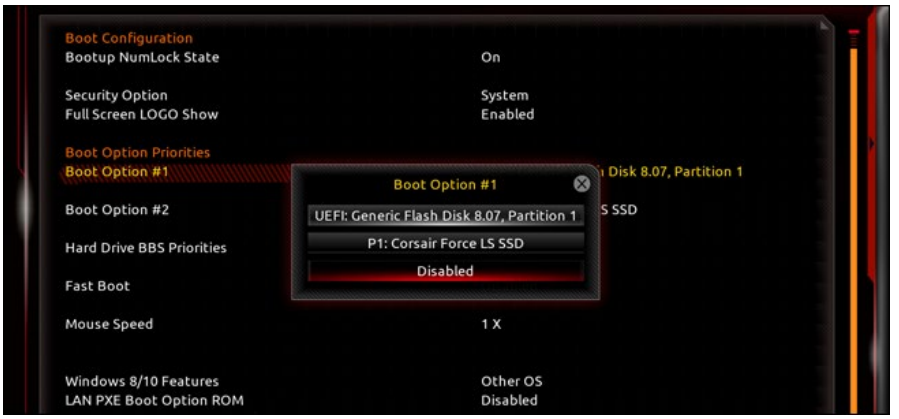
1. Download the updated UEFI file from the Gigabyte website (on another, working computer, of course).
2. Transfer the file to a USB drive.
3. Plug the drive into the new computer, start up UEFI, and press F8.
4. Follow the on-screen instructions to install the latest version of UEFI.
5. Reboot.

Your motherboard and BIOS/UEFI will follow the same general steps, but not necessarily exactly. You can usually find the process with a quick Google search. If for some reason you can't get it working, don't worry: motherboard manufacturers also frequently offer programs that can update the BIOS/UEFI once you get Windows up and running, too.

Check Your Storage Drives

Next, check to make sure that your motherboard can recognize your storage drive. If it can't, the Windows setup utility you use in the next article won't have anything to install to.

The instructions here are unfortunately going to be a bit vague because every company's UEFI program is laid out differently. All we're trying to do is find the page that manages the storage drives. On our Gigabyte motherboard, this is found under the "BIOS" tab (because the new UEFI includes all of the old "BIOS" settings, you see).



I've selected "Boot Option #1," the first thing that the BIOS will attempt to boot. If this fails, it will continue to the second option. Under the available list, you can see the Corsair solid-state drive we installed in the last article. If you're installing your operating system with a DVD drive, make sure you can see it here too. (Sometimes both are labeled "SATA" for their motherboard connections.)

If you don't see your drive or drives, double-check the power and SATA data cables in your case. If you've verified that they're connected and you still can't see the drives in BIOS, you may have to replace them.

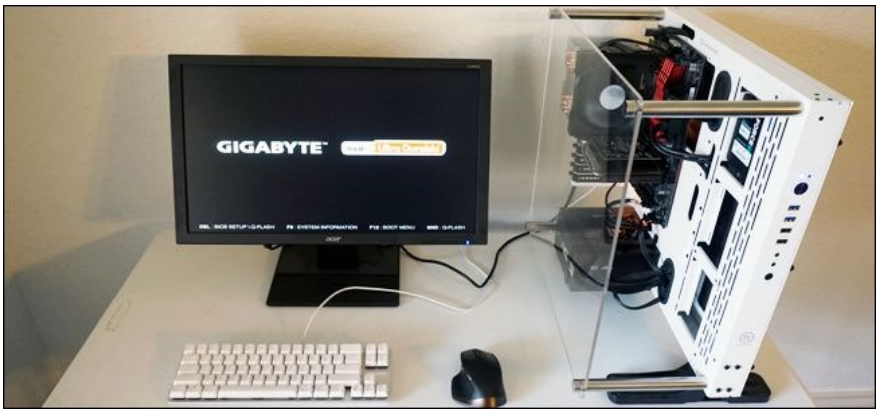
Going Further with Other Tweaks

You can do other things with your computer's UEFI or BIOS, but none of it is necessary to get an operating system up and running. Here are some of the more interesting options in the BIOS and UEFI we recommend checking out, as long as you feel comfortable doing so:

- Enable Intel XMP to Make Your RAM Run at Its Advertised Speeds
- Auto-Control Your PC's Fans for Cool, Quiet Operation
- Enable Intel VT-x in Your Computer's BIOS or UEFI Firmware for Virtual Machines
- Secure Your Computer With a BIOS or UEFI Password
- The Pros and Cons of Windows 10's "Fast Startup" Mode in the BIOS

Once you're done with everything in the BIOS and UEFI, it's time to install Windows. Note that you'll need another working computer with access to the Internet if you don't already have an installation disc or USB drive ready.

Part Four: Installing Windows and Loading Drivers



Much like configuring the BIOS, installing a new copy of Windows used to be a bit of a chore, but these days it's been streamlined amazingly well. For most of it, you'll simply follow the on-screen instructions, but feel free to keep this page open if you get stuck.

Before we start: make sure to plug in an Ethernet cord to your motherboard if you don't have a Wi-Fi adapter. Windows will want access to the Internet when it starts up.

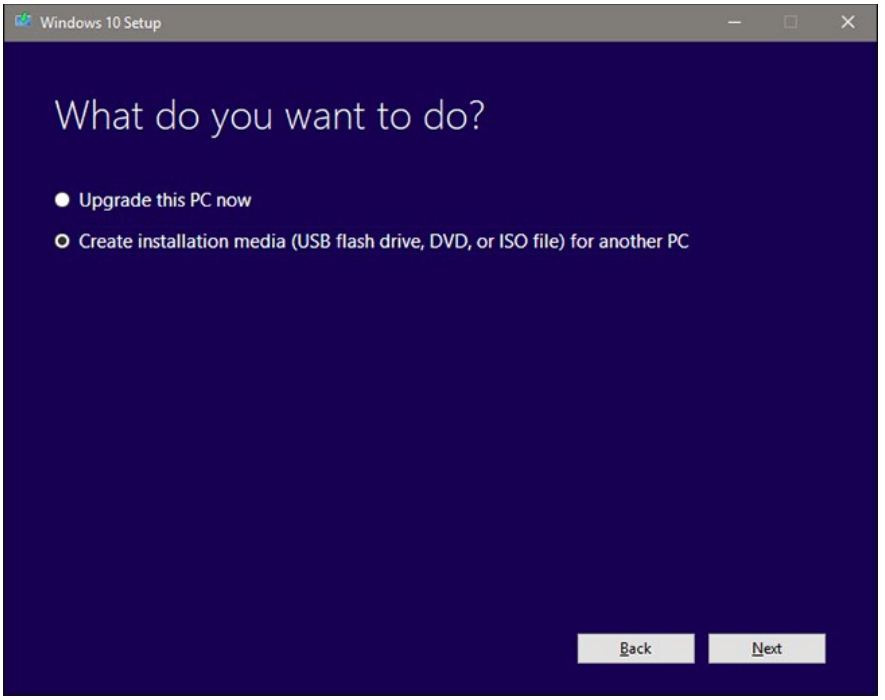
Step One: Prepare Your Installation Disc or Drive

For this guide, we're going to download the latest build of Windows 10 and place it on a USB drive, which our computer will boot to install Windows. That's generally the easiest way to go about it these days. Of course, you can do more or less the same thing with an installation disc sold from a retail store (if you've installed a DVD drive), or burn your own.

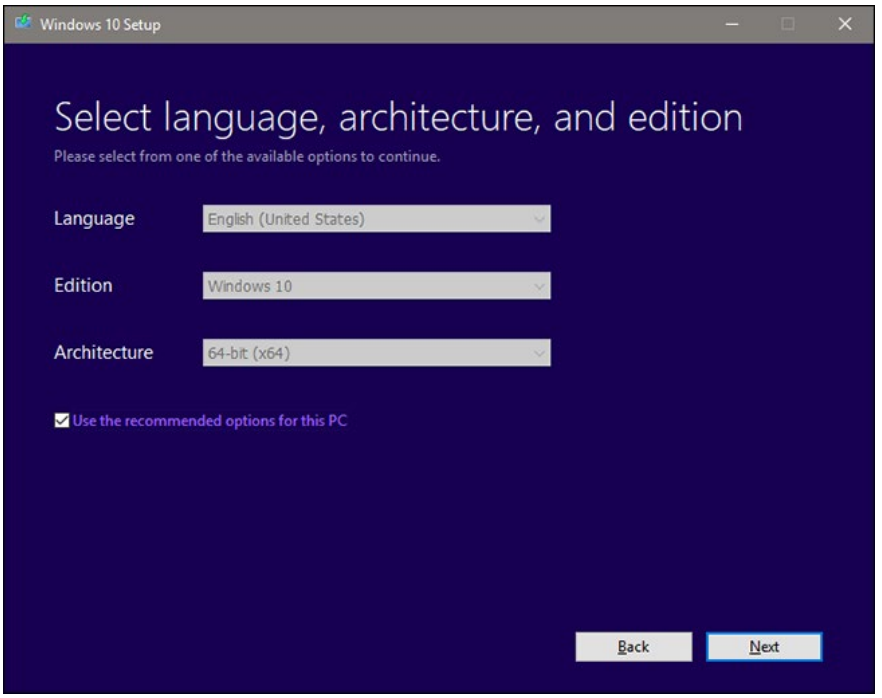
Obviously, you can skip this section if you already have an installation disc or USB drive ready.

Head to this website on another Windows computer and download the Media Creation Tool from Microsoft. Plug in a blank (or unimportant) flash drive with at least 8GB of space. Note that the installation process will delete anything stored on this USB drive, so if you have anything on it, move it somewhere else now. Double-click the program, then follow the steps below.

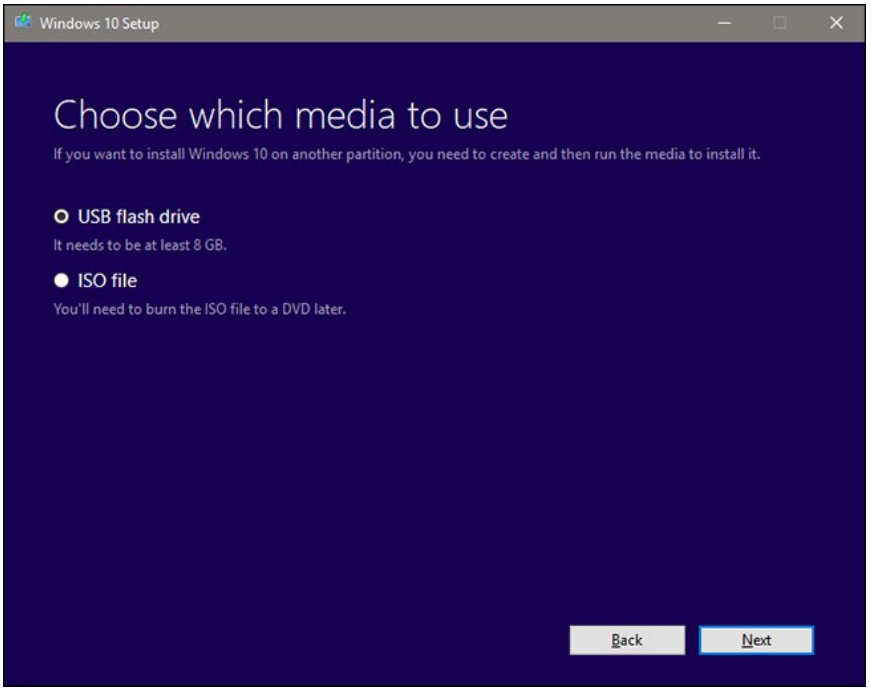
Click "Accept" on the software license page, then choose "Create installation media." Click Next.



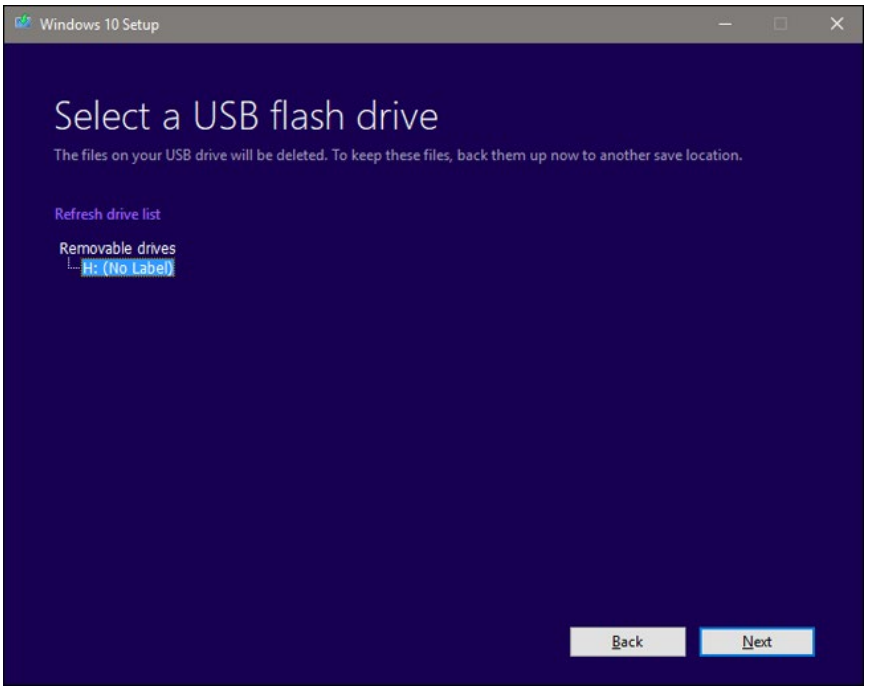
Make your language and edition selections. Keep "64-bit" set. Click "Next."



Click "USB flash drive," then "Next." (If you're burning to a DVD instead, you can choose "ISO file," and burn it to disc after it's downloaded).



Select the blank USB drive you just inserted. (If you're not sure which drive this is, check "My Computer" or "This PC" in the File Explorer to find out.) Click Next.

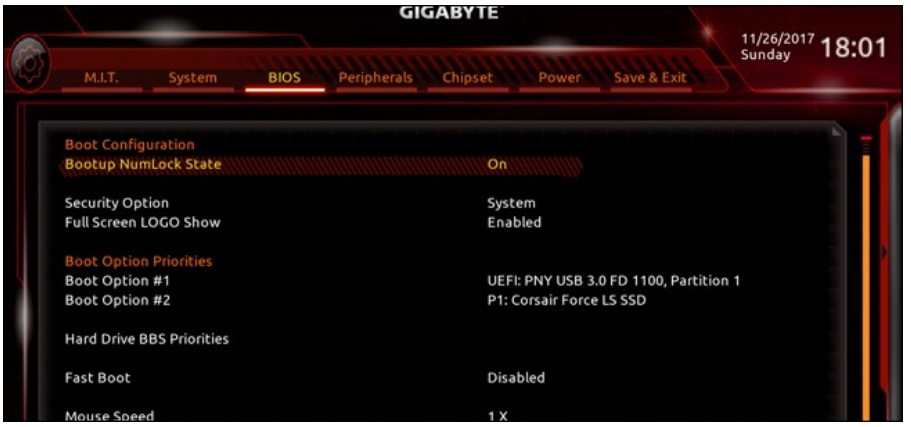


The tool will download the operating system files, load them on the drive, and get it ready for installation. Depending on your Internet connection, this will take somewhere between ten minutes to an hour. You can do other stuff on the computer you're using while it works. Or you can watch an old *Fresh Prince of Bel-Air* reboot.

When the tool is done, click "Finish" and unplug the USB drive from the working computer.

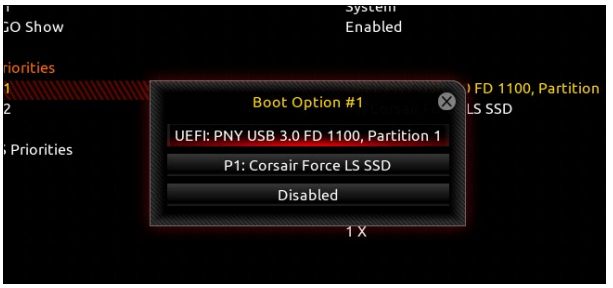
Step Two: Install Windows on Your New PC

Plug the drive into a USB port, then power on the PC and follow the on-screen prompt to start the UEFI or BIOS (just like we did in part three).

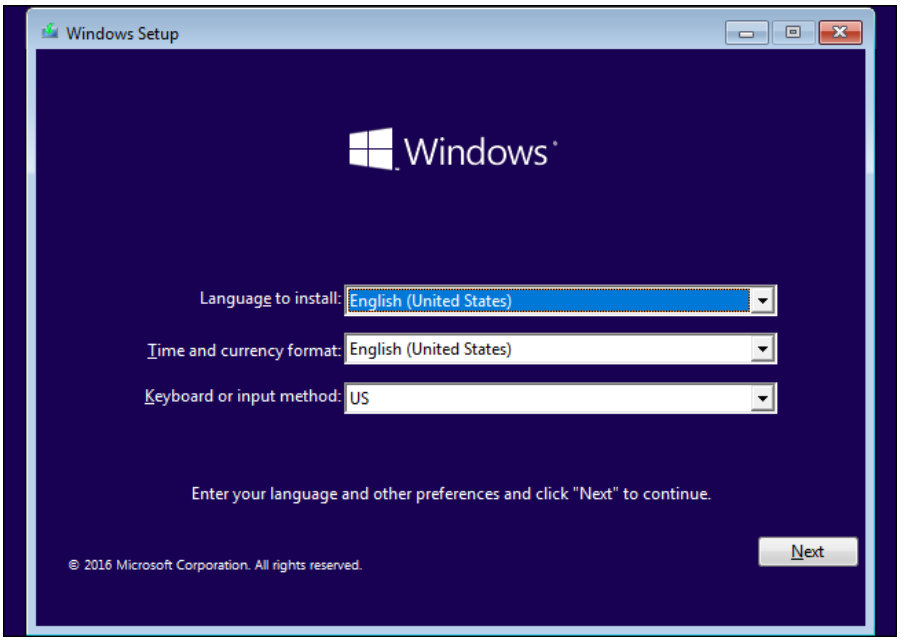


Find the section of your UEFI/BIOS that controls the boot order---this is the numbered order of the various hard drives, SSD drives, and DVD drives in your computer, in which order the BIOS will search for a bootable partition. Since our demonstration computer only has an SSD installed, we can see the blank SSD, plus the Windows installation USB drive we just created and inserted.

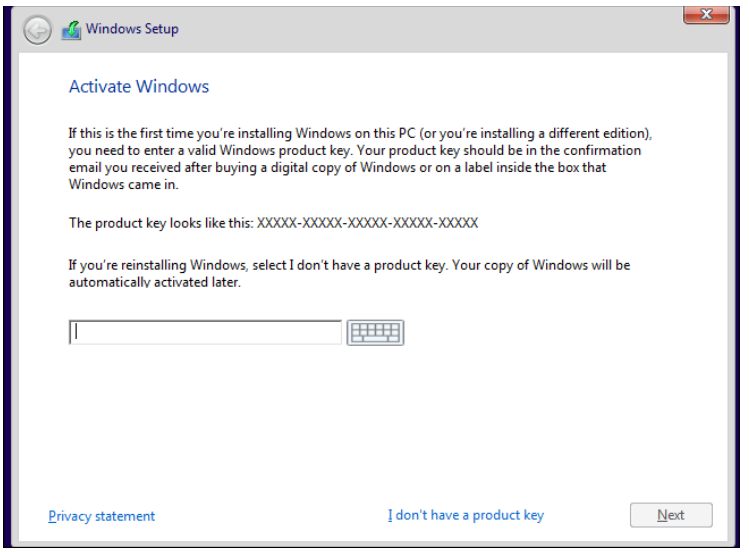
Set the first boot drive to the USB drive. (Or, if you're using a retail Windows DVD, select the DVD drive.) Save your settings in UEFI/BIOS, then restart your computer.



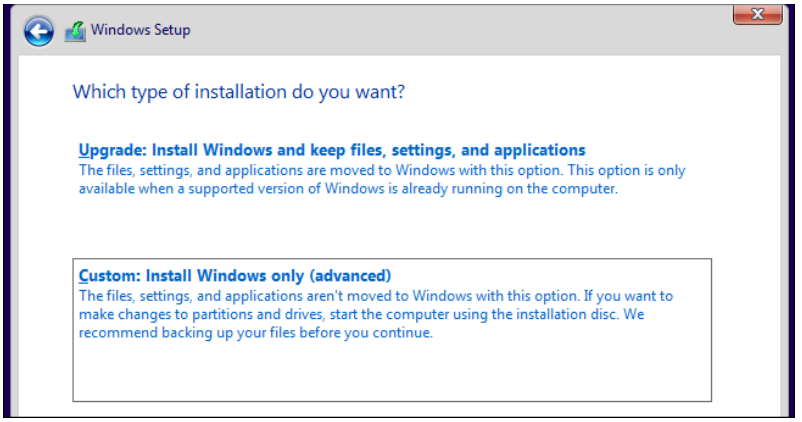
With the boot order set in the BIOS, you should see the Windows 10 installation program start automatically after you reboot. Select the appropriate language and input options, then click "Next." Click "Install now" on the next screen.



If you have a Windows key, input it on this screen and click "Next." If you don't, no sweat: just click "I don't have a product key," then select the version of Windows you want to use (either "Home" or "Pro" for most people). You can input your key in Windows itself later, or buy one from Microsoft at your leisure---technically, you don't even need one to use Windows 10.

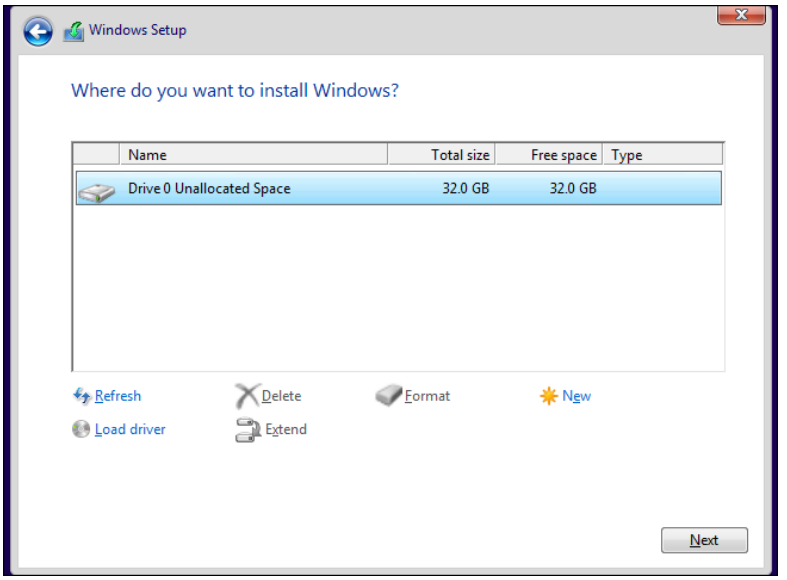


On the next screen, click "Custom" for a manual installation. You're going to set up the Windows partition on your PC yourself.

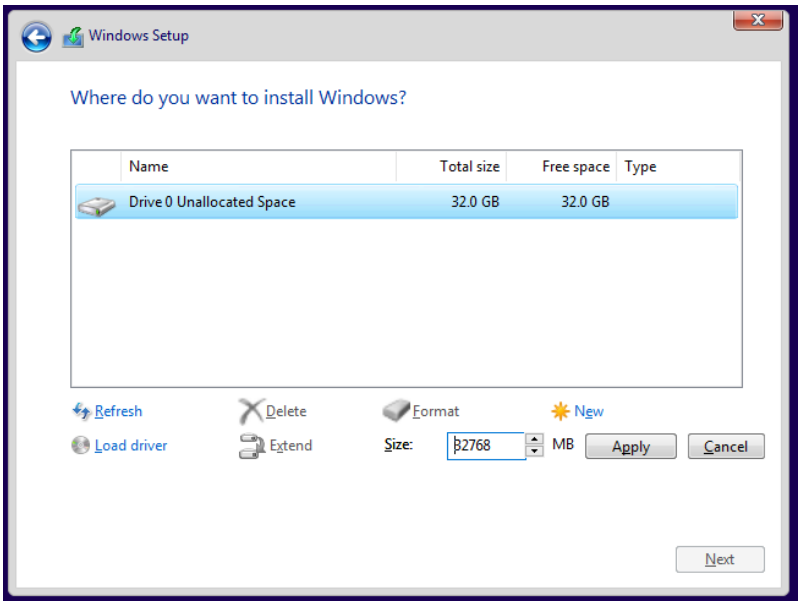


Assuming you're using a single new hard drive or solid-state drive, your screen should look something like this. If you have multiple drives installed, there will be multiple items with "Unallocated Space," listed in order as Drive 0, Drive 1, Drive 2, and so on. The order of these drives doesn't matter; it's based on the order of the SATA ports on your motherboard.

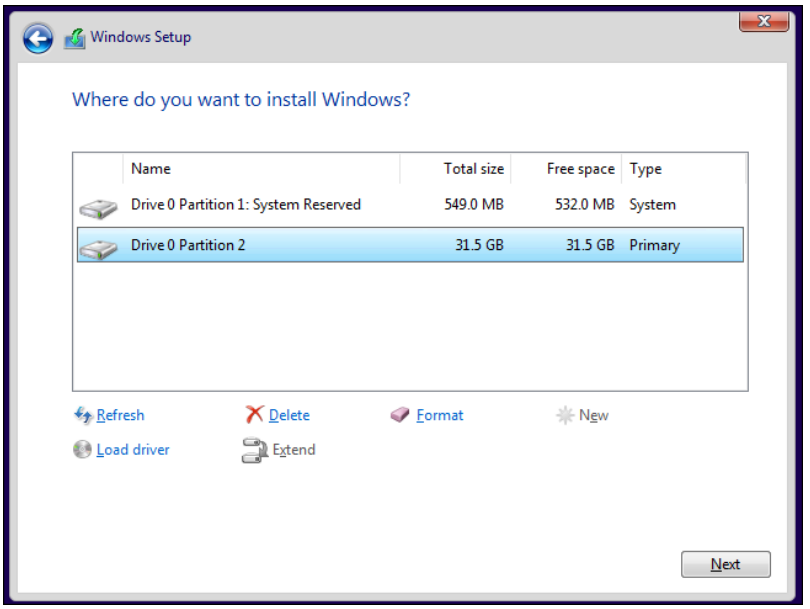
NOTE: If you're using a drive from a previous PC, you'll want to highlight each partition and click "Delete" to remove it, reassigning the data to the Unallocated Space pool. This will destroy the data on the partition.



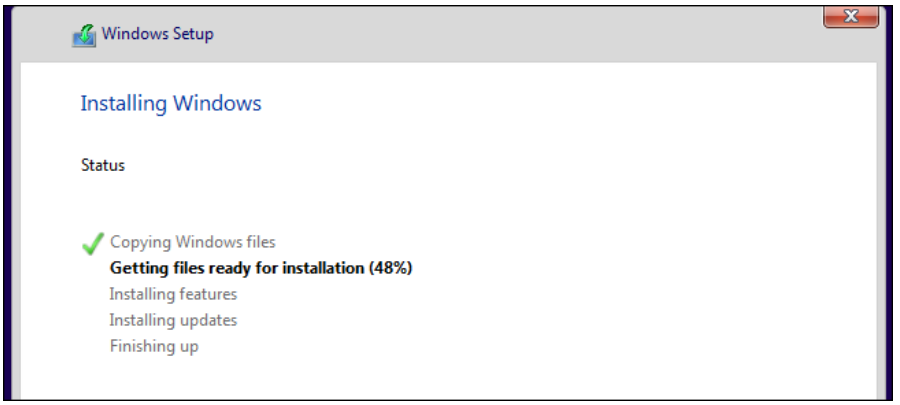
Select the drive you want to install Windows on, and click "New" to make a new partition on the drive. Choose the maximum amount of data available for your drive when prompted. Click "Apply" to create the partition, then "Okay" as Windows gives you an alert message about multiple partitions. It will create some new partitions, which Windows uses for various pre-boot and recovery tools.



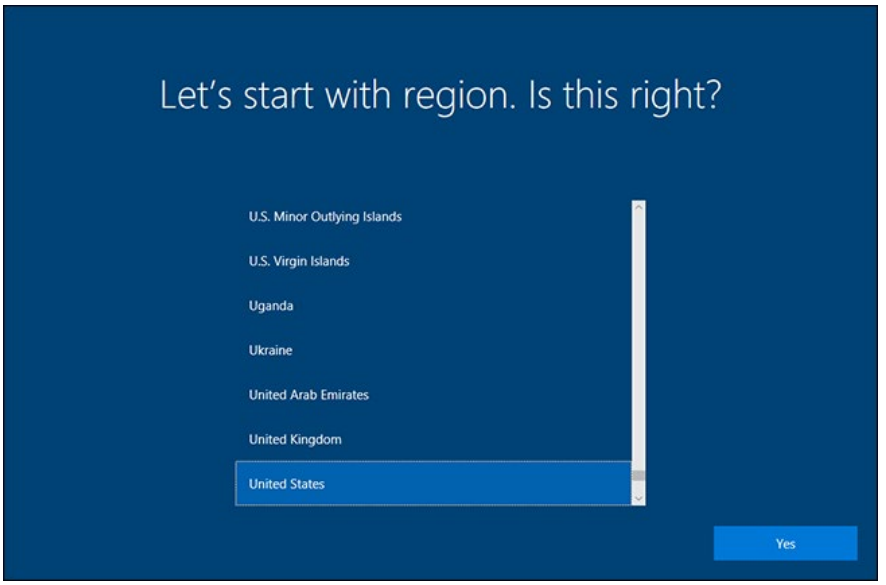
Click the biggest new partition, which should be the largest in size and market "Primary" in the "Type" column. Click Next.



Now Windows is copying files from the USB drive or DVD to your storage drive, installing the OS, and generally getting stuff set up for you. It may restart the computer several times; this is fine. The process will take somewhere between a few minutes and an hour based on variables like your storage type, processor speed, USB drive speed, et cetera. Go watch another episode of *Fresh Prince*.



When you see the following screen, Windows is installed, and you're ready to set it up. Just follow the instructions and create your account. Going through the setup process shouldn't take more than about 15 minutes, and you'll be dropped onto the familiar Windows desktop.



When you're finished, and you see the login screen, there's one more thing you need to do. Shut down your computer, unplug the Windows installation USB drive, turn the computer back on, and go into the BIOS again. Go back to the drive boot order setup, then select "Windows Boot Manager" as the first boot option. This will keep your PC from looking at any USB or DVD drives for a bootable operating system---you can change this setting back if you want to re-install Windows or something else later on.

That's it. Now you can restart your computer to boot into Windows, and get ready to set it up!

Step Three: Install Drivers for All Your Hardware

Unlike older versions of Windows, Windows 10 comes pre-installed with thousands of generic and specific drivers, so some of your hardware---like network, audio, wireless, and video---should have at least basic functionality.

However, there are still some drivers you'll probably want to install:

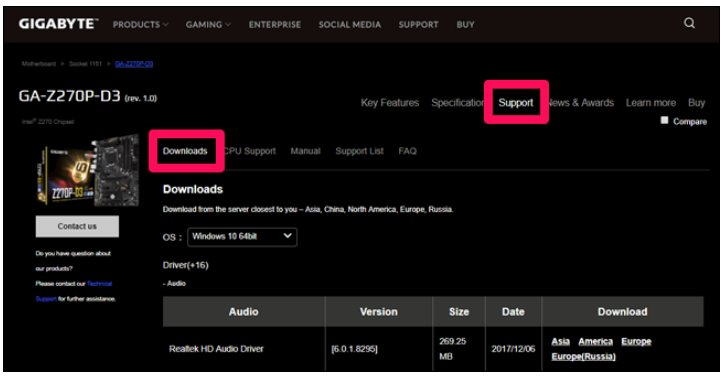
- **Your motherboard's chipset, audio, LAN, USB, and SATA drivers**: Windows' drivers are probably fine, but your motherboard manufacturer may have newer, better optimized, or more feature-filled drivers. Head to the Support page for your motherboard and find the Downloads section---that's where you'll find all these drivers. You don't necessarily have to install everything on that page, but the chipset, audio, LAN, USB, and SATA drivers are usually worthwhile.

- **Graphics card drivers from NVIDIA and AMD**: Similarly, your discrete GPU will probably work fine with Windows' basic drivers, but it won't be fully optimized without the latest driver from the manufacturer. You'll want this if you've installed a graphics card for gaming or media applications. (Note: download the driver straight from NVIDIA or AMD, not from the card's manufacturer like EVGA or GIGABYTE).

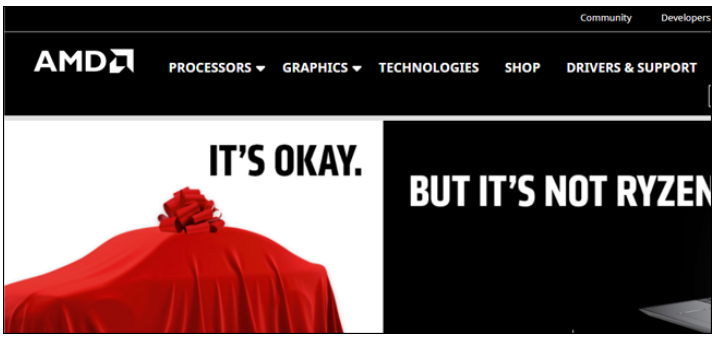
Input devices like high-end mice, keyboards, and webcams: Peripheral manufacturers like Logitech usually need you to install a program to take advantage of advanced features, like custom shortcuts or sensor adjustments. Again, this is especially important for gaming-branded gear.

- **High-end and unique hardware**: if you have anything out of the ordinary, like, say, a Wacom graphics tablet or a PCI adapter for older ports, you'll want to track down specific drivers and install them manually.

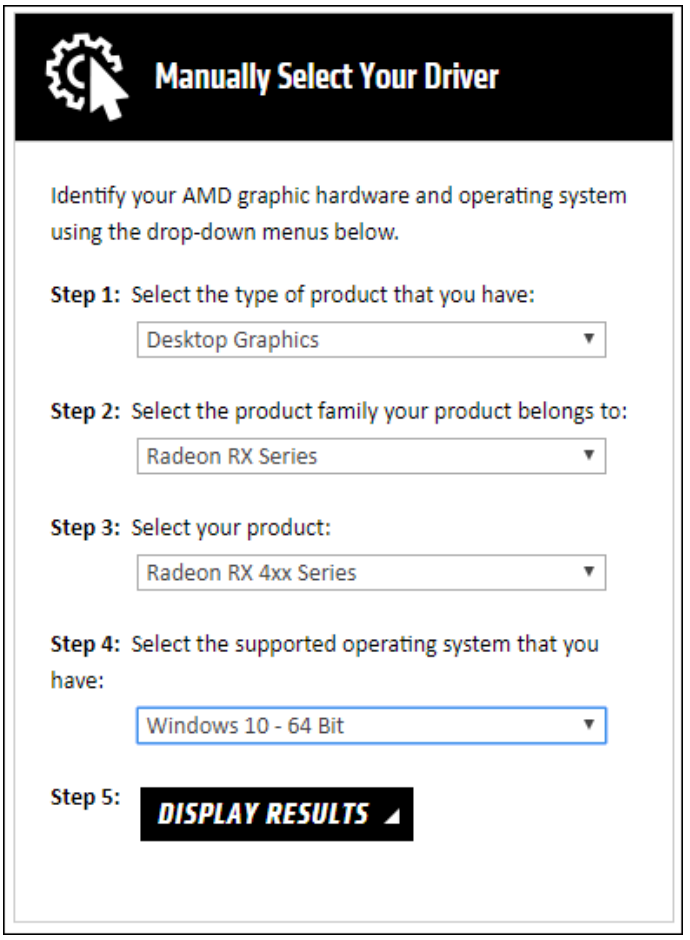
Again, more or less, all of these additional drivers can be found on their manufacturer's website, downloaded, and installed like a standard program through the web browser of your choice.



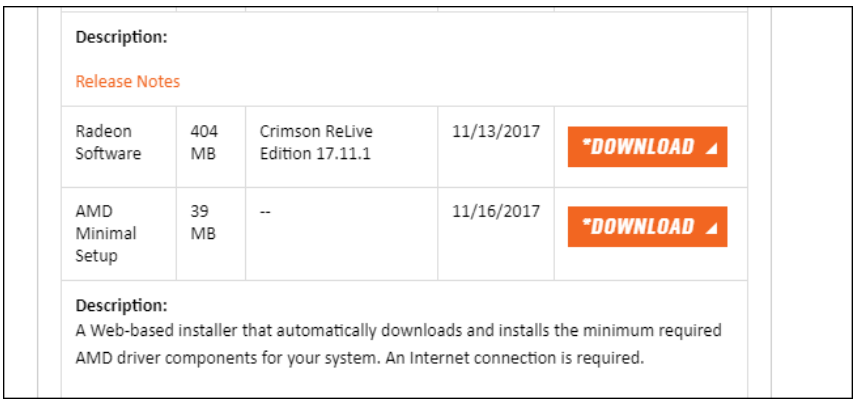
Let's install the AMD driver for our PC's graphics card as an example. The box says the graphics card is an AMD Radeon RX 460, and I have no reason to suspect the model number is lying to me. Right on the front page of the AMD website is a link to DRIVERS & SUPPORT.



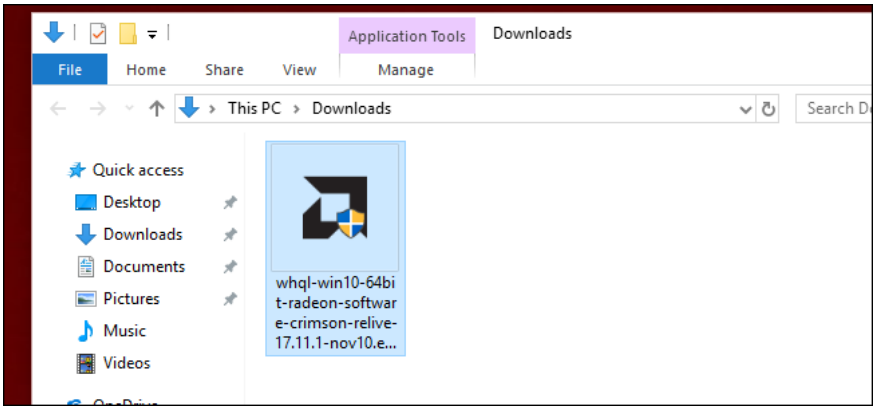
This has both a downloadable detection program and a quick driver search tool. I'd rather not install more than I have to, so I use the latter to select my model:



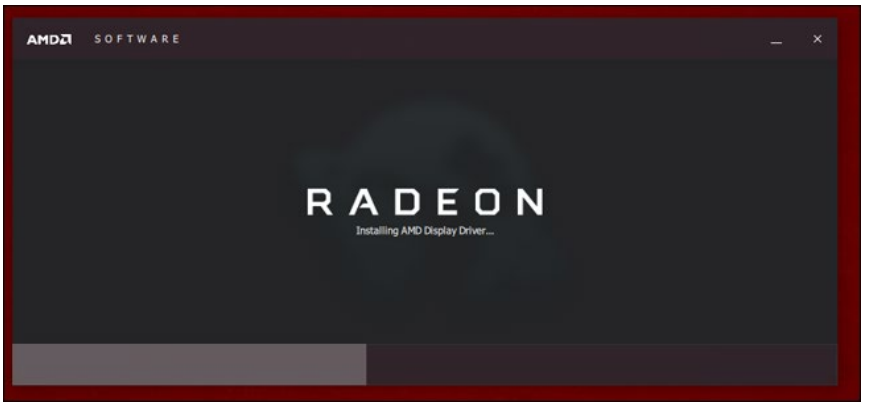
Then you can choose the full version of the latest download.



Clicking "Download" saves the latest driver package as an EXE file on my PC. (Note: graphics cards drivers tend to be big, several hundred megabytes. Give it a minute or two.)



Double-click the program, follow the on-screen instructions, and your driver will be installed in a few minutes. You may need to reboot the PC to get it to start up, that's fine.



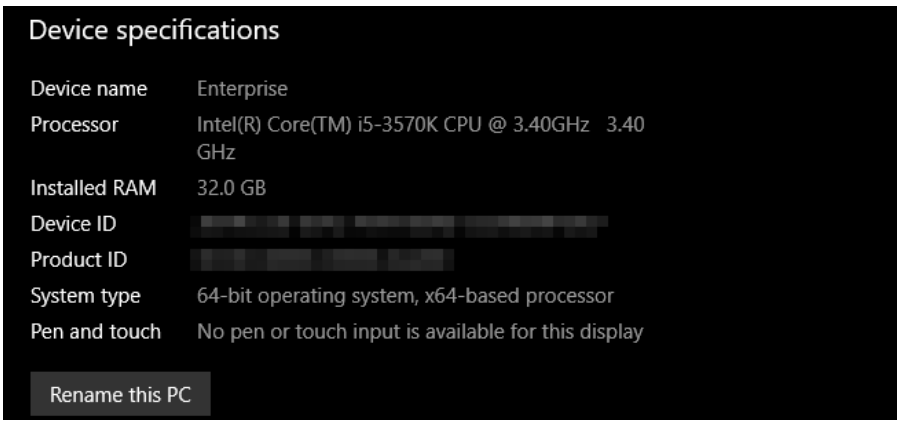
Repeat this process for any hardware that isn't automatically detected by your PC. When you're sure all the hardware is working, you can put on the finishing touches by tweaking your new PC.

Part Five: Tweaking Your New Computer

Congratulations, you've successfully selected parts, assembled your PC, and installed Windows! Before you jump into whatever it is you built your rig for, you probably want to take a few minutes to update and protect your shiny new PC. Here are a few steps you should take before doing anything else.

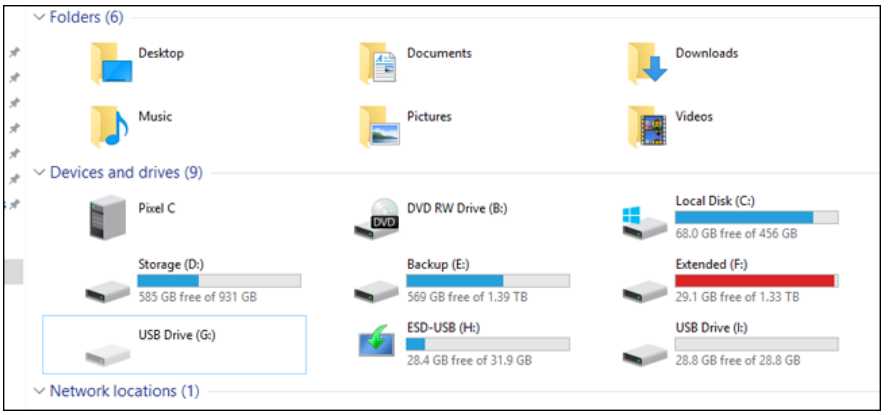
Check Your Hardware

Before we do anything else, check to make sure that Windows is correctly detecting all that hardware you installed. First, press the Windows button on your keyboard, then type "About." Click the link to "About your PC" that appears in the Start menu.

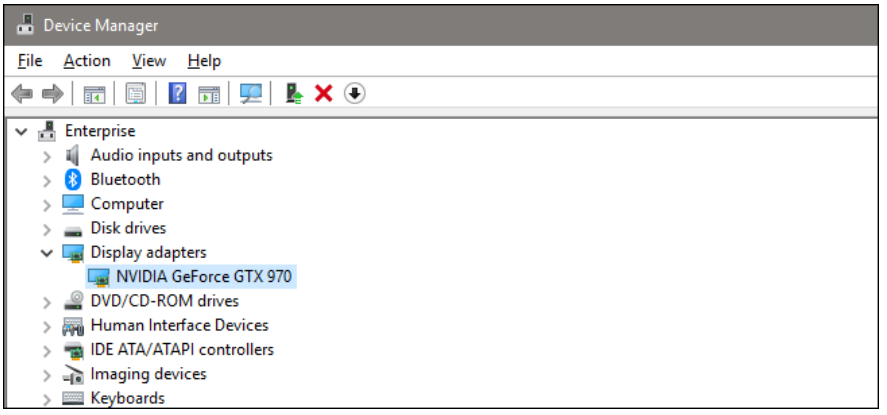


You'll see the PC's name, the processor model and speed, and the amount of RAM detected by the system. The RAM is particularly crucial here: make sure the total matches what you installed. If it doesn't, you may have a faulty RAM DIMM or one of them may not be properly seated. Shut down the PC and check the RAM on the motherboard.

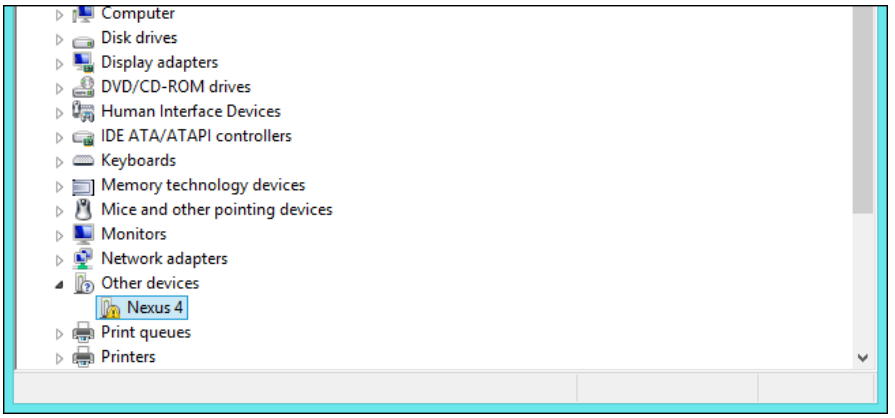
Next, press the Windows button and type "This PC," then click the first result. Here you'll see a list of all your account folders and the computer's installed drives; make sure that the number of drives and their storage amount is the same as what you were expecting.



To check for other hardware components, like the graphics card or the front USB panel, press the Windows button and type "Device Manager" then click the first result. This window has a nested list of every single component installed in your computer, including all the little stuff on your motherboard you probably haven't even thought about. If you're looking for something specific, just check under the relevant label. For example, graphics cards are listed under "Display Adapters."



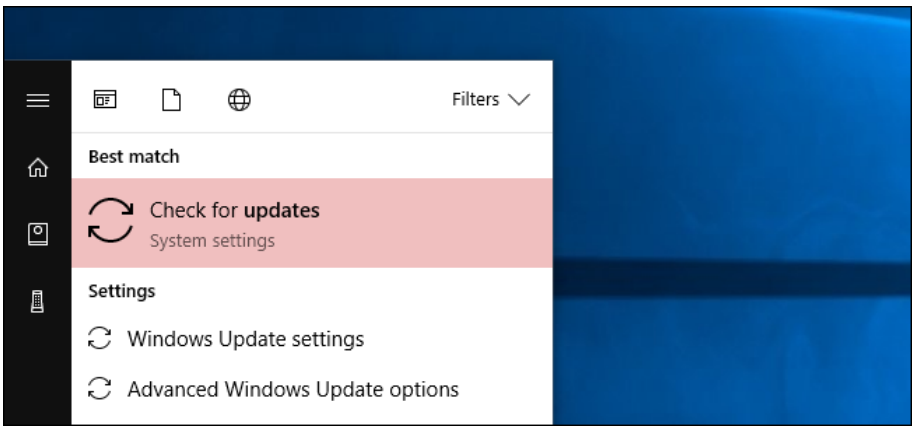
If anything is connected, but not recognized or installed with an appropriate driver, it will show up with a yellow icon and sometimes be labelled "Unknown device." You'll need to track down a driver for it.



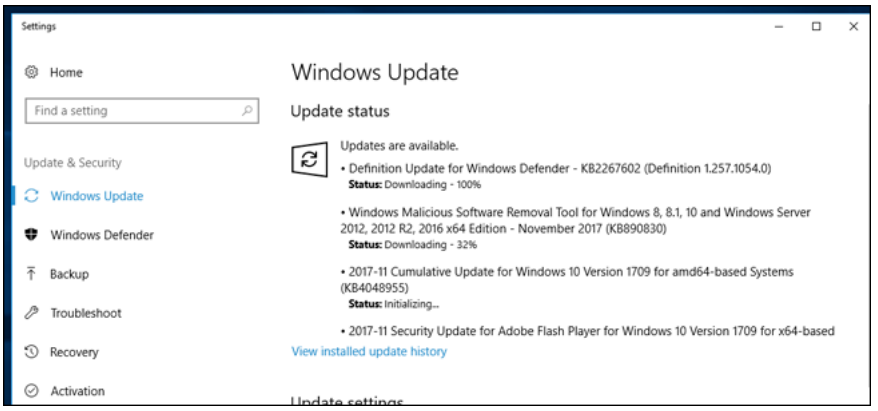
Keep Windows Updated

Yes, updating Windows is time-consuming and boring. It's also one of the most important parts of keeping your computer running well. And since Microsoft updates the operating system more frequently than they do the Windows ISO or the Media Creation Tool, you probably need some updates right off the bat.

Luckily, this is a really easy process. Press the Windows key on your keyboard, type "updates," then click on the first result in the Start menu, "Check for Updates."



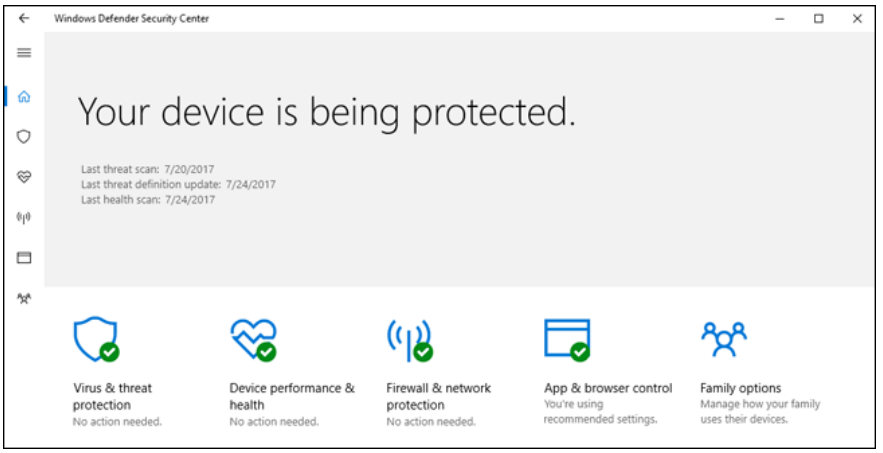
This is the Windows Update section of the Windows 10 settings menu. Just click "Check for updates," and the OS will call out to Microsoft's servers and download the latest necessary files, then install them. You may need to reboot to apply the larger updates.



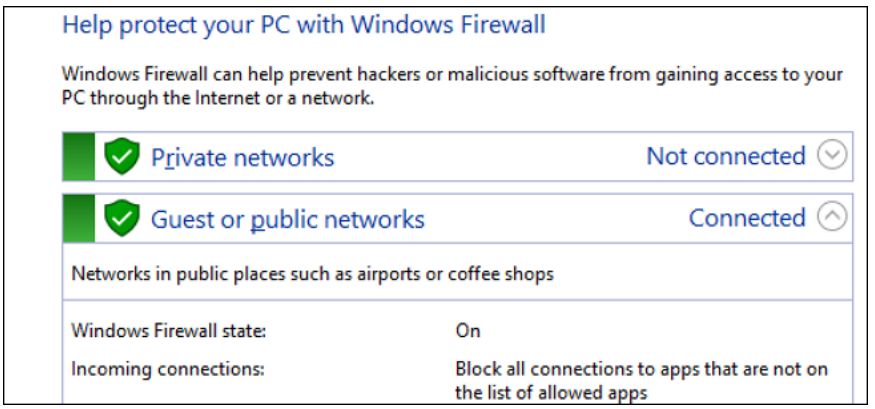
Windows 10 has a nasty habit of rebooting itself without your permission if it's sat too long with un-applied updates. Here's how to solve that problem.

Set Up Your Antivirus and Anti-Malware Software

Back when I started building PCs, everyone seemed to have a different recommendation for anti-virus and firewall programs. But things have gotten a lot simpler since then. Microsoft has developed its own built-in antivirus solution that comes free with Windows, and it's actually pretty great. It's called Windows Defender. You don't even need to do anything to keep it working---Windows Update will keep its list of harmful viruses, trojans, and other nasty stuff updated automatically, and it will alert you if it detects anything. You can check out this guide for more on how to use and configure Windows Defender though if you like.

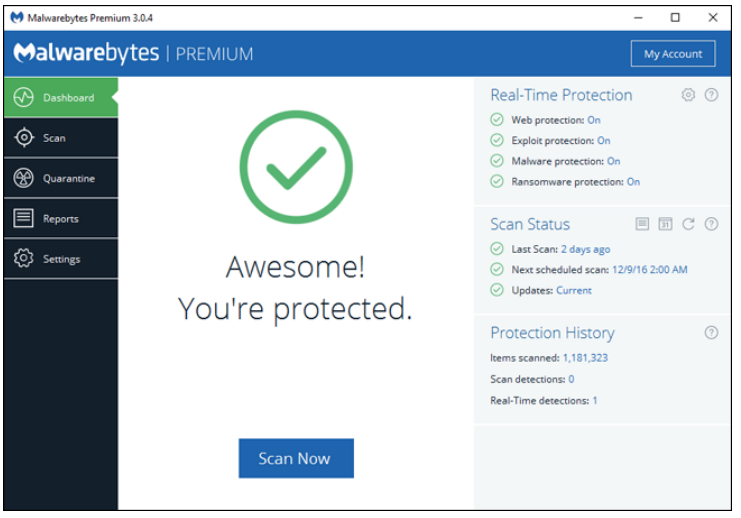


The built-in firewall for Windows (also under the "Defender" brand name) is more than adequate. Like Windows Defender, it runs by default and updates itself in the background. Third-party apps will alert you if they request permission to access outside servers as you go along. For advanced firewall management, check out this guide.



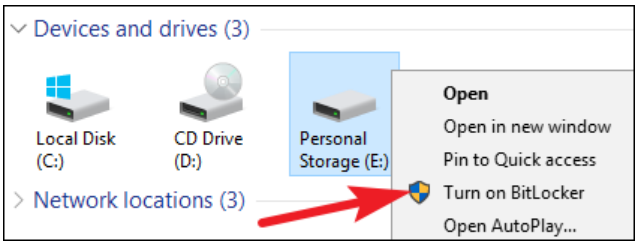
We also recommend installing Malwarebytes Anti-Malware as well. It's a bit more aggressive than Windows' built-in tools, especially when it comes to stopping browser exploits and things like that. Think of it this way: Windows Defender is designed to stop malware you put on your system, Malwarebytes is designed to stop malware before it even gets to your system.

If you want always-on protection---and we highly recommend it---you'll need to pay for Malwarebytes Premium for $40 per year. You download Malwarebytes for free and run occasional scans, but Malwarebytes' real power comes from its anti-exploit protection. You can get a beta version of anti-exploit for free to run alongside Malwarebytes' free version, and this will at least get you some---but not all---of the protection of the premium version.



Secure Your Drives

Encryption is a security measure that allows you, and only you, to access that data. Anyone without your password or other identifying information won't have access to it even if they steal your computer or drive---the only option they'll have is to wipe it completely.



Windows 10 Pro has a built-in encryption tool called Bitlocker. It's really easy to set up: go to the "This PC" folder in Windows Explorer, right-click on any drive, and then click "Turn on BitLocker." You'll then be asked to create password (it can be different from your Windows password) or use a flash drive as an unlock key.

Note that *the cheaper Windows 10 Home release doesn't include BitLocker features*. If you want extra protection, you'll need to either upgrade your license (available from the "About your PC" settings menu) or encrypt your drive with a third-party program like VeraCrypt.

You're Done!

Now you can do whatever you want with your PC. You'll probably want to start by installing the Chrome or Firefox web browser. You may also want to check out these essential How-To Geek Windows articles for more ideas:

- Basic Computer Security: How to Protect Yourself from Viruses, Hackers, and Thieves
- What's the Best Way to Back Up My Computer?
- How to Keep Your Windows PC and Apps Up to Date
- How to Make a Program, File, and Folder Start with Windows
- How to Re-Enable System Restore (and Repair System Problems) on Windows 10
- How to Make Old Programs Work on Windows 10
- How to Make Windows 10 Look and Act More Like Windows 7
- How to Install Custom Themes and Visual Styles in Windows

You can see even more Windows tweaks and guides at our Windows portal. Enjoy your new PC!